ENGINEERING NEWS

PRESIDENT HOWELL of the Brooklyn Bridge Trustees, in an interview in the Brooklyn *Eagle*, says that the scheme for carrying that end of the bridge to the City Hall is definitely given up and the east terminus will be at Sands and High streets. The so-called BARNES plan will be carried out; but the work of the bridge extension will not be started until next spring as—"the bridge travel does not demand at the present time any considerably enlarged facilities." The contracts for this work are to be given out about Jan. 1, and in one year the whole will be completed. The Brooklyn *Eagle* echoes the sentiments of many bridge travellers this hot weather, in questioning this decidedly cool way of disposing of a matter which affects the traffic facilities between two great cities and the comfort and convenience of people using this structure to the extent of over 2,500,000 trips per month. The *Eagle* very sensibly remarks that what the bridge should have is an ampler, broader terminus on either side, with adequate and wholly reconstructed terminal facilities. This radical problem has not yet been touched, and the abandonment of a scheme which only proposed to extend the present narrow line of end-approach is something that any sensible person would have done long ago.

JUDGE COLT'S decision in favor of the Thomson-Houston Electric Company, of Boston, against the American Electric Mfg. Company, of New York, for infringement of the automatic regulation of electric lighting apparatus, is said to be the first favorable decision ever had by any plaintiff in a suit brought to test the validity of a patent relating to electric lighting. Several other companies will have to abandon the manufacture of automatic regulators under this decision. As the Thomson-Houston now lays full claim to the automatic device, and as it is said to be absolutely unsafe to operate a dynamo without this device, local electric light companies using any other than the Boston system will be likely to suffer injury and serious loss.

THE Philadelphia *Press*, with the interest of Pennsylvania properly at heart, believes it is a mistake to make "big guns" at the Watervliet Arsenal, when Pennsylvania is the natural home of steel and iron manufacture. And there is reason and common sense in the objection, too.

THE drawings of the proposed 28-story building to be erected in Minneapolis, Minn., have been completed by Mr. BUFFINGTON, the originator of the scheme, and copies distributed. The front and side elevations are said to resemble somewhat the new court-house tower in Pittsburg. The building is to be a continuous skeleton of iron 80 ft. square, 350 ft. high and containing 728 rooms. There will be a square court-yard in the center, but all the rooms are to face the outer sides of the building. The roof will be of iron surmounted by a glass apex or tower. The exterior will be of stone. Twelve elevators and two flights of stairs will be provided, and the elevators will be so arranged that one serves only two floors, thus permitting a continuous and quick passage to the top of the building. There will be no woodwork about it except the doors and windows. Safes for the various offices will form a part of the permanent structure

THE quickest long distance railway journey ever made in this country, except the flying trip of AUGUSTIN DALY across the continent by special train without a change, was recently made, says the New York *Times*, by Mrs. G. B. MARKLE, of Hazleton, Pa. She travelled from Portland, Ore., to Chicago by special train over the Northern Pacific; from Chicago to Philadelphia by the Limited Express, and was conveyed from Philadelphia to Hazleton by the Directors' car of the Lehigh Valley Railroad. The distance travelled, more than 3,000 miles, was accomplished in 84 hours. Mr. DALY made 3,313 miles in 84½ hours.

THE attendance at the Cleveland Meeting of the American Association for the Advancement of Science numbered 330 members. Among the papers and discussions of interest to engineers the following may be enumerated. aside from those given last week:—American Ship-Building, by CHAS. S. HILL, of Washington; Aluminum and Cast-Iron, by W. J. KEEP, C. E.; The Economical Production of Charcoal for Blast Furnace Purposes, by Prof. OLIN LANDRETH, Vanderbilt University; The Influence of Moisture in Steam upon the Steam Consumption per Horse Power of Engines of Less than 50 Horse-Power, by Prof. J. E. DENTON, who also read a paper on The Possibilities of Identifying Dry or Saturated Steam by Visual Observation of such Jet Flowing in the Atmosphere, and a third paper on The Relativ Economy of High Speed Engines of Less than 50 H. P. using Steam by Expansion and Throttling Respectively. Dr. WILFRED NELSON gave an entertaining talk on the Panama Canal, illustrated by photographic views.

MINNEAPOLIS, Minn., is testing underground telegraph and light cables. The National Subway Co. is to at once commence laying conduits in the main streets. Two separate conduits in a trench 4 ft. deep and 4 ft. wide will contain telegraph and telephone cables in the one and electric light and power cables in the other. The conduits will be each 14×20 in. and are made of the DORSETT insulating compound. Each conduit section is 4 ft. long and weighs 500 lbs. and the ducts for the wires are 2½ ins. in diameter.

THIS week 150 lbs. of chemically pure metallic aluminum were shipped to England; the first export of this kind from the United States. It was smelted from Kentucky ore and clay by a process yet tedious and secret. So says an exchange.

Dr. R. J. GATLING, the inventor of the gun of that name, is reported to have taken out patents for a new system of heavy ordnance, from which much is expected. Instead of "building-up", as in the Continental and English practice, or boring out a solid steel casting, as lately proposed and to some degree tested in this country, Dr. GATLING casts his steel around a central core, as Gen. RODMAN made his cast-iron gun. A reduction of 50 per cent. in cost for a gun of equal power is promised and two 6-in. guns are to be made to test the practicability of the system.

DURING the week there have been very severe storms of rain and wind in several sections of the country, causing serious and damaging floods. At Philadelphia, Pa., sewers were burst by the flood. Navigation had to be stopped on the Lehigh canal. Washouts have occurred on numerous railroads and several landslides are reported. Cyclones occurred in Maryland, New Jersey and Michigan. The rainfall in New York from 8 A. M. to 8 P. M. on the 21st was 2.25 ins. and at Pittsburg, 3 ins. In Louisiana much damage has been done to the plantations by storm and flood. Washouts have occurred on the New York, New Haven & Hartford, Pennsylvania, West Shore, Baltimore & Ohio, Louisville & Nashville, Illinois Central, Denver & Rio Grande, and other roads. The storm swept over nearly the entire territory of the United States and is said to have been the most severe of its kind since 1882.

IN our list of bridge accidents on page 99 we mentioned the collapse of a span of the "Baltimore & Ohio bridge over the Youghiogheny, near Connellsville, Pa." Mr. G. B. HAZLEHURST, Engineer of Bridges & Tests, B. & O. R. R., writes to correct this statement, as the company did not build or own the bridge and had no responsibility in connection with its maintenance or inspection.

THE following bridge accidents are reported: At Chaplin, Conn., a wooden highway bridge over the Natchaug river has collapsed.——The stone bridge at Telfair St, Macon, Ga., has been damaged by the storm.——At Denver, Col., a railroad bridge has been washed out.——On Aug. 21, the railroad bridge, and the stone bridge, 140 ft. long, at Main St., Wheeling, W. Va., fell, being injured by the floods. ——Reports of the damage done by the storm include mention of a number of bridges destroyed, including 6 on the Pittsburg division of the B. & O., and several others in the same State.

THE most serious railway accident of the week was a crossing collision at Chicago, Ill., Aug. 16., in which a Grand Trunk freight train crossing the Illinois Central tracks at South Lawn, was cut in two by an express train running into Chicago at a rapid speed. Judging from sketches in local papers the tracks were about at right angles. The engineer of the express stated that on coming down the grade toward the crossing, he found that the air brakes would not work, and seeing the freight train on the track, he whistled for the danger brakes, but it was too late to stop the train. Seven persons were injured. The passenger train was badly wrecked, as will be seen from the following extract from a local report:

"The engine of the passenger stopped on the tracks a hundred yards from the crossing, stripped clean of everything but her truck and boiler. Her tender toppled over into the ditch, with its running gear scattered in all directions. The baggage car fell on its side in the ditch, as did the postal car next behind. They filled the ditch completely, and the creek at its bottom flows through their stove-in ends. One coach and an express car were left crossways of the track, while their torn and twisted running gear ran down the embankment. Another coach plunged headlong through the platform to the bottom of the ditch, and came within a yard or two of demolishing the depot. Two car-loads of hard coal were scattered over the crossing and dumped into the ditch. Half a dozen tons of pig iron helped to make kindling wood of one coach and one freight car when the crash came. The speed of the passenger train was so great that a car of pig iron and one of coal were torn apart and thrown outward as though they had been folding doors of a barn. Two rails were torn from the ties and were gashed half an inch deep by the flanges of wrecked freight trucks. The scene resembled a section of the path of a cyclone."

ENGLISH papers received give more accurate particulars of the collision on the London & Southwestern Railway at Hampton Wick, near London, Eng., on Aug. 6. The accident occurred at night. An empty train had arrived at Kingston Junction and the signalman at the junction (who had charge of a signal cabin containing 39 levers) put the switches right for the engine to run into the shed as usual, but the fireman told him that the engine was going back again. He forgot to switch the engine onto the up line, and it started back on the down line; neither the engineer nor fireman noticing anything wrong. The collision occurred shortly after. The signalman discovered his mistake in "about 15 seconds" and telegraphed to Hampton Wick. The report states that the man was experienced and perfectly sober.

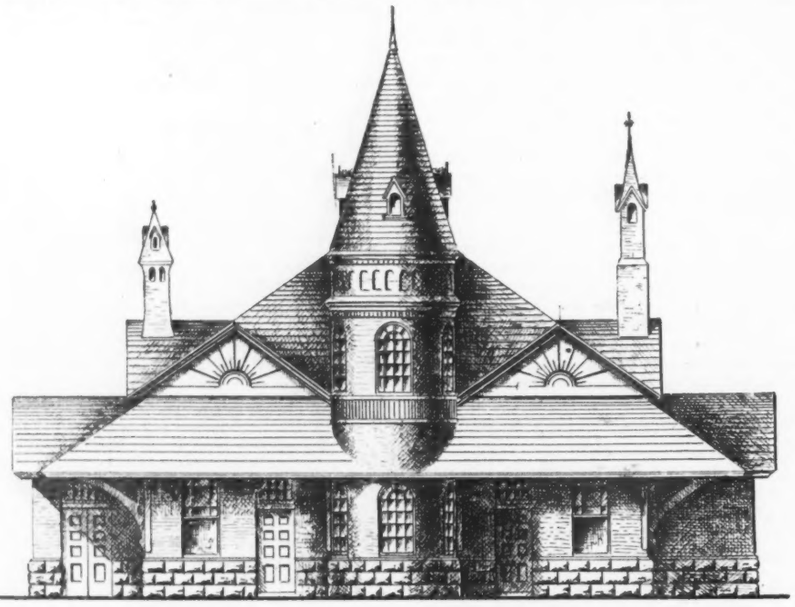
THE *City of New York*, which left our port one week ago, has not yet had a fair opportunity of testing her powers, and probably will not have until she has made several round trips and had her weak points detected and the remedies applied: But rivals are soon to be in the field to contest with this latest racer the honors of the Atlantic passage. According to the Liverpool *Journal of Commerce*, her sister ship, the *City of Paris*, will be launched in about 5 weeks, and she may beat the *City of New York*. But the competitors most feared are the two vessels now building for the White Star Line, at the shipyard of Messrs. Harlen & Wolff, at Belfast. The builders of the "*Umbria*" and "*Etruria*" are also erecting another vessel for the Cunard or the Guion line, (whichever may invest in her,) which ship will be 560 ft. long, 63 ft. beam, 52 ft. depth of hold, and have accommodations for 1,000 first-class passengers, besides second-class and steerage. She will be strengthened by 17 water-tight bulkheads and be propelled by twin screws; and while her engine power is not stated, the makers promise the Atlantic trip in 5 days. The White Star ships are to be longer than any vessel afloat, except the *Great Eastern*; they will have triple-expansion engines, twin screws and uniquely arranged propellers, one being further aft than the other and overlapping its mate. The makers promise "developements" in ocean steamship building.

THE citizens of Lincoln, Neb., consider that they have a fair prospect of having located in that town a plant for the manufacture of steel passenger and freight cars. Hon. H. D. PERKY is named as the General Manager for a company of Boston capitalists. The "City of Lincoln," the first car made on this new plan has already been described in this journal. The location of the plant depended on the donation of certain land by the city of Lincoln, and this matter is reported to have been satisfactorily arranged.

CHICAGO has two new bridges of steel over its river. The bridge built at Jackson St. is 280 ft. long and has two roadways, each 21 ft. wide and two 7 ft. footways. It is a swing-bridge with the low pier on one side of the river. It cost $318,341. The Wells St. structure is a double-track steel swing bridge and is to cost $150,000.

Suburban Railway Stations.

In this issue another design is given for a suburban railway station, with front elevation and ground plan. It has the same general dimensions



Front Elevation of Suburban Railway Station.—J. D. Fouquet, Architect.

as that given in our issue of Aug. 4, and the general description for exterior and interior finish will apply to both. The chief difference is in the roof treatment and the addition of the tower. Mr. J. D. Fouquet, Mem. Am. Soc. C. E., is the architect for both designs.

English Railway Accidents in 1887.

Mr. Courtenay Boyle has made a General Report to the English Board of Trade upon the accidents which have occurred on the railways of the United Kingdom in 1887. From this the following abstract is made :—

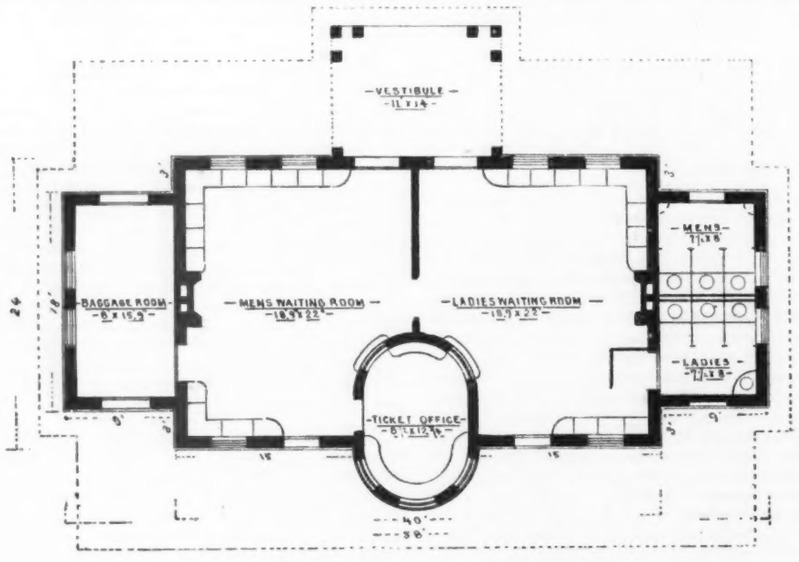
The total number of persons returned to the Board as having been killed in 1887 in the working of the railways is 919, and 3,590 were injured. Of this number 121 killed, and 1,297 persons injured were passengers; but of these only 25 were killed, and 538 wounded in consequence of accidents to or collisions between trains. The death or injuries of the remainder were due to a variety of other causes, and especially want of caution on the part of the individuals themselves.

Of the remainder, 422 killed and 2,075 injured were officers or servants of the railway company, or of contractors. There were 70 suicides; 203 trespassers killed and 114 injured; 63 persons were killed and 35 injured at grade-crossings of the railways; and 40 killed and 69 injured from miscellaneous causes. In addition to the above, the companies have returned 58 persons killed, and 4,157 injured by accidents on their premises not connected with the movement of railway trains.

The total number of passenger journeys, not including journeys by season tickets, was 733,670,000 for 1887, or 8,085,610 more than in the previous year. Based on these figures, the proportions of passengers killed and injured during the year, from all causes, were 1 in 6,064,000 killed, and 1 in 565,667 injured. In 1886, the proportions were 1 in 7,637,730 killed and 1 in 540,674 wounded.

There were 58 train accidents in 1887, as compared with 62 in 1886, 60 in 1885, 105 in 1884, 94 in 1883, 118 in 1882, 111 in 1881, 118 in 1880, 100 in 1879, 108 in 1878, 146 in 1877, 149 in 1876 and 161 in 1875. Last year only one fatal accident to passengers arose from causes beyond the control of the passengers; this was the terrible collision at Hexthorpe.

Of the various train accidents, 11 were due to defects in connection with the track; 10 arose from trains entering station at too great speed; 1 accident was due to defect in rolling stock; there were three collisions between following trains on the same line; 2 collisions at junctions; 52 collisions within fixed signals at stations or sidings, 3 of these were due to negligence or mistakes of the signalmen and 13 to want of care in the engine-drivers; 6 accidents happened from collisions between engines or trains meeting in opposite directions. There were no accidents at grade crossings of two lines, and 3 accidents from facing points conclude the list.



Floor Plan of Suburban Railway Station.

Of the accidents to railway employés, 26 were killed and 232 injured while coupling and uncoupling cars; 89 were killed and 720 injured in various shunting operations; 9 were killed and 55 injured by being caught between cars; 5 killed and 33 injured by falling between train and platform; 99 were killed and 97 injured while working on the permanent way and sidings, and 93 were killed and 127 injured while walking on, crossing or standing on the line on duty.

The absolute block and interlocking signal system is adopted to the following extent :—The proportion in which the signal and point, or switch levers have been interlocked on railways was 93 per cent. in England, 79 per cent. in Scotland, 56 per cent. in Ireland, and 89 per cent. for the United Kingdom. This is an increase of 1 per cent. in the past year. In 1873, 6,217 miles out of 16,082 miles of railway opened were worked on the block system. At the end of 1887 this system had been adopted on 14,842 miles out of 18,556 miles open to traffic. In England and Wales, at the end of 1887, 12,005 miles out of 13,053 miles open were so worked; in Scotland 2,280 out 2,808 miles; in Ireland only 557 miles out of 2,695 miles have the block system. The proportion of double and single lines now operated on the block system is 92 per cent. in England; 81 per cent. in Scotland, and 20 per cent. in Ireland. The proportion of double lines worked on the block system is 97 per cent. in England and Wales; 98 per cent. in Scotland, and 29½ per cent. in Ireland. The total for the United Kingdom is 93 per cent. There are still 2,388 miles of line working on the train staff system, more than one-half of this being in Ireland.

The continuous brakes, complying with some or all of the conditions laid down by Parliament, are now applied to 74 per cent. of the vehicles in use; and another 15 per cent. are fitted with pipes and connections only. The report concludes by calling the attention of Parliament to the reduction of the excessive working hours of engine-drivers, firemen, guards, etc., as one of the means for the decrease in accidents.

Water Waste and its Prevention, with Special Reference to Metering and Minimum Rates.*

On November 1, 1882, Hoboken, N. J., had 16 miles of water mains laid, with a population of about 33,000 people. For 25 years previously Hoboken had been supplied under the house-rate system, by the water-works of Jersey City. When the new supply was turned on, the first six months consumption showed a daily demand of nearly 4,000,000 galls. Mr. Brush was convinced that one-half of this was waste simply, and he at once took prompt action to check it, without restricting the legitimate use of water. The result has been to save about 1,500,000 galls. per day; reducing the waste about equally on mains and that due to consumers.

The following table shows a comparison of the results obtained during the first six months of the first and fifth years of the new supply.

	Six months from November 1, 1882, to May 1, 1883.	Six months from November 1, 1887, to May 1, 1888.
Population	33 000	41 000
Taps, Unmetered	2 667	2 648
Taps Metered	47	822
Total Taps	2 714	3 470
Daily Draft, United States Gallons, Unmetered	3 471 645	2 022 843
Metered	459 099	945 975
Total	3 930 744	2 968 818

Mr. Brush does not charge this entire result to the attachment of meters, but to other precautions

*Abstract of paper read by Mr. C. B. Brush at last Annual Convention of the Am. Soc. C. E.

in addition. House to house inspections were made twice a year, as well as night inspections of the mains and service pipes. The reduction of waste in service pipes was mainly due to meters, however, used where consumers were supposed to be most wasteful. This is given as not only the most effectual method of restricting consumers but of determining leakage from mains where metering is universal.

The pressure is now 25 per cent. higher on the mains than before this waste was checked.

There is no minimum rate in Hoboken, and in a well built-up district accustomed to a public water supply, the same necessity does not seem to exist for minimum rates as in a locality that has never had such a supply. Even in new localities, the amount of water used increases as consumers become better acquainted with the advantages of a public supply, because they find it more economical to obtain water from that source than from existing wells. Nevertheless, in the new districts, after three years' trial without it, the Hoboken Co. were obliged to establish a low minimum rate.

In order to illustrate the ideas he wished to convey, Mr. BRUSH submitted the following tables as showing the actual effect of the attachment of meters during the Fall of 1885 on 439 houses in Hoboken, previously supplied for many years on the House Rate System:

Consumers.	Former House Rates.	Present Meter Rates.	Difference.
Nov. 1, 1885, *to Feb.* 1, 1886.			
			Loss.
83 per cent. reduced.....	$2,978.39	$2,047.92	$ 930.47
17 " " increased....	687.41	1,042.73	355.32
	$3,365.80	$3,090.65	$ 575.15
Feb. 1, 1886, *to May* 1, 1886.			
			Gain.
63 per cent. reduced.....	$2,382.13	$1,433.28	$ 948.85
37 " " increased....	1,424.87	2,610.50	1,185.53
	$3,807.00	$4,043.78	$ 236.68
May 1, 1886, *to Aug.* 1, 1886.			
59 per cent. reduced.....	$2,254.88	$1,453.26	$ 801.62
41 " " increased....	1,566.95	2,775.17	1,208.22
	$3,821.83	$4,228.43	$ 406.60
Aug. 1, 1886, *to Nov.* 1, 1886.			
57 per cent. reduced.....	$2,188.45	$1,447.16	$ 741.29
43 " " increased.....	1,633.38	2,813.29	1,179.91
	$3,821.83	$4,260.45	$ 438.62
Nov. 1, 1886, *to Feb.* 1, 1887.			
72 per cent. reduced.....	$2,751.72	$1,941.04	$ 810.68
28 " " increased.....	1,070.11	1,948.81	878.70
	$3,821.83	$3,889.85	$ 68.02
Feb, 1, 1887, *to May* 1, 1887.			
			Loss.
75 per cent. reduced.....	$2,684.71	$1,606.88	$1,077.83
26 " " increased.....	1,025.35	1,661.09	635.74
	$3,710.66	$3,267.97	$ 442.09
May 1, *to Aug.* 1, 1887.			
			Gain.
58 per cent reduced.....	$2,216.67	$1,558.00	$ 658.67
42 " " increased.....	1,605.16	2,737.72	1,132.56
	$3,821.83	$2,895.72	$ 473.89
Aug. 1, 1887 *to Nov.* 1, 1887.			
62 per cent. reduced.....	$2,431.26	$1,580.34	$ 850.92
38 " " increased....	1,405.16	2,450.43	1,045.27
	$3,836.42	$4,030.77	$ 194.35
Nov 1, 1887, *to Feb.* 1, 1888.			
67 per cent. reduced.....	$2,477.78	$1,709.49	$ 768.29
33 " " increased.....	1,160.37	1,981.67	821.30
	$3,638.15	$3,691.16	$ 53.01
Feb. 1, 1888 *to May* 1, 1888.			
70 per cent. reduced.....	$2,650.14	$1,947.87	$ 702.27
30 " " increased,....	1,059.92	1,833.83	773.91
	$3,710.00	$3,781.70	$ 71.64

In order to ascertain the effect of the meter system in a new district, 191 average dwellings were selected connected with the high service plant, which contained about 8 occupants to each house. These houses were metered. If house rates in each case had been charged, the daily draft *per capita* would have been about 75 galls., and the following result would have been obtained:

Houses.	Annual Revenue.	Daily Draft.
191	$2,645.48	115,000 galls.

The following have been the actual results:

	Annual Revenue.	Daily Draft.
First six months, winter.....	$1,081.32	12,880 galls.
Second " summer.....	1,617.26	18,948 "
Third " winter.....	1,510.44	18,000 "
Fourth " summer.....	1,859.94	24,000 "
Fifth " winter.....	1,385.17	16,550 "
Sixth " summer.....	1,959.24	23,000 "
Seventh " winter.....	1,751.52	21,645 "
Eighth " summer.....	2,083.84	25,387 "
Ninth " winter.....	1,825.92	22,516 "

At house rates each house would have averaged $13.85 per annum.

At meter rates the actual return was $9.56.

At rate of first six months,	winter....	$ 5.66	per annum
" second "	summer....	8.46	"
" third "	winter	7.90	"
" fourth "	summer...	9.74	"
" fifth "	winter ...	7.58	"
" sixth "	summer...	10.25	"
" seventh "	winter	9.16	"
" eighth "	summer...	10.91	"
" ninth "	winter....	9.56	"

Each corresponding period shows a constantly increasing use of water.

It will be noticed that in a metered district the draft in winter is less than that in summer. In unmetered districts the reverse is the case. During the extremes of cold and hot weather the draft *per capita* is about the same in both districts, but after the extreme weather has passed, the waste in the metered district immediately ceases, while in the unmetered district the waste continues for some time.

Classification of Consumers of the High Service District of the Hackensack Water Company, reorganized, according to Amounts paid annually previous to the Establishment of a Minimum Rate. All the Consumers were Metered.

Classification Amt of Water consumed per annum.		No of Consumers in each Class on Quar end'g Feb. 1886	Nov. 1885	Aug. 1885	May 1884	Feb. 1885	Nov. 1884	Aug. 1884	May 1884	Feb. 1884
Bet. $0	& $ 2.	164	107	57	118	127	66	37	66	66
2 "	4.	192	165	123	125	107	93	60	46	52
4 "	6.	124	106	67	62	71	67	37	30	25
6 "	8.	55	72	65	38	36	40	32	12	20
8 "	10.	43	45	37	32	30	19	22	16	13
10 "	12.	40	20	39	22	15	16	9	10	8
12 "	16.	49	52	36	21	24	31	24	12	9
16 "	20.	26	27	29	17	14	21	9	5	7
20 "	40.	58	55	69	52	32	37	31	10	7
40 "	80.	12	17	10	10	9	11	7	8	2
80 "	200.	7	5	10	10	4	5	5	4	4
Over $200		5	5	6	5	5	4	4	3	3
Total		775	676	548	522	474	410	277	222	216

It will be seen from this table that during the latest quarter, 356 consumers, out of a total of 775, used less than $4 worth of water per annum, and practically this proportion of small consumers appears in each of the nine quarters given. In order to check this extreme economical tendency of some of the consumers in a new district, the company was obliged, during the year 1886, to establish a low minimum rate depending upon the size of the meter attached to the consumer's service pipe.

The result of the experience of this water company is that the meter system is mutually advantageous, both to the consumer and the company. Each metered consumer pays only for the water he uses, and there are no restrictions either as to quantity used or the time of use. No inquisitorial examinations of premises, so unpleasant to consumers, are required. It is the interest of each consumer to have good plumbing: Those who are careless and wasteful, and those who require or desire to use more than an average amount of water, must and should pay for such excess, but the balance, constituting two-thirds of all the consumers, pay less by meter than by house rates. Meters were attached only after intense and prolonged opposition. Common sense prevailed, however, and now they are quite popular.

The experience of this company to date indicates that the true policy of a Water Board is to furnish meters and keep them in repair free of expense to the consumer, except in case of misuse or freezing. The meters are then entirely under the control of the Board, who will naturally see that repairs are promptly made. The consumer's interest is rather to see that such repairs are delayed.

The following is an extract from a letter Mr. BRUSH received from WM. G. RICHARDS, Superintendent of the Water-Works at Atlanta, Ga.:

"Our works are city property, and are used for almost any and all purposes for which the city can use water, such as puddling ditches after laying sewers or water mains, flushing sewers, and frequently for washing gutters, so that anything like a comparison of the pumping with the meter records would be an impossibility. Then, the public schools are not metered, the city claiming the right to use all the water they want.

"Meters were introduced here as an absolute necessity. The pumpage had become so great that, with our machinery, it was impossible to maintain a satisfactory pressure, and the city was not in a condition to put in more pumping machinery and a larger main. Meters have now been in general use here about 3 years, and the pumpage does not reach an average of 2,000,000, and before their general introduction it frequently reached 5,000,000 per day. Our number of consumers has regularly increased, but the waste is stopped, and the pressure is satisfactory all over the city."

Mr. BRUSH remarks that it is unfortunate that the question of metering is almost synonymous in the public mind with injustice and jobbery. Until a community can be educated so as to grasp the importance of the subject, both from a pecuniary and a sanitary standpoint, and until the moral sense of a community can be sufficiently advanced not to tolerate rascality, such a community will have to suffer and retrograde. The public will learn in time, however, that in most localities the amount of desirable water that can be obtained is limited—that even if it can be obtained in abundance the expense of the supply depends directly upon the quantity—and that the danger to the public health, public safety and the public welfare is directly in proportion to the amount of waste.

LOSS OF WATER FROM MAINS.

In November 1883, the Hackensack Water Co. began metering, and thereafter metered every consumer in each new district it supplied. This is the first instance, apparently, where such radical action had ever been taken. Since that time, Princeton has adopted the same policy, but with this exception the writer did not know of any other locality where every service is actually metered, though there are many places where a large majority of the taps are metered.

In consequence of universal metering this company is enabled, in certain districts, to ascertain the difference between the amount of water supposed to be delivered into the mains and the amount drawn through the service pipes of consumers,

The balance may be grouped as follows:

A.—Water drawn through fire hydrants for fire purposes, flushing mains, street sprinkling, etc.

B.—Slip of pump.

C.—Slip of meters.

D.—Clerical errors.

E.—Leakage from mains.

What becomes of this balance is a question which is receiving earnest consideration. All the meters are tested on large and small streams and found correct before they are attached, and when they are taken off for examination or repairs they are tested and are rarely found inaccurate to a greater extent than 3 per cent.; usually they come considerably within that limit. As yet sufficient data has not been collected to determine the proportions of the balance which should be credited under each of the above heads, but the total of the actual balance and such data as is on hand in each case is submitted and it is left for readers to draw their own conclusions.

HIGH SERVICE DISTRICT.

The amount of water delivered into these mains is measured by the displacement of the high service pumps. The mains are from 4 ins. to 16 ins. in diameter, and 22.37 miles long. There are 1,459 consumers from these mains, and 195 fire hydrants on this system. The pressure ranges from 25 to 75 lbs. per sq. in.

Quarter Ending.	No. of Consumers.	Daily Delivered to Mains. U. S. Galls.	Daily measured by separate Meters. U. S. Galls.	Daily Balance. U. S. Galls.	Balance per cent.
Nov. 1, 1883..	180	45 076	16 213	28 863	64
Feb. 1, 1884..	227	75 444	33 314	42 130	55
May 1, 1884..	284	88 785	43 939	44 845	51
Aug. 1, 1884..	418	137 306	75 886	61 420	45
Nov. 1, 1884..	487	125 709	77 593	48 116	38
Feb. 1, 1885..	539	107 508	74 038	33 470	31
May 1, 1885..	570	138 636	101 503	37 133	27
Aug. 1, 1885..	702	176 979	130 195	46 784	27
Nov. 1, 1885..	771	179 385	109 629	69 756	39
Feb. 1, 1886..	804	166 256	110 537	55 719	33
May 1, 1886..	830	207 027	126 996	80 031	38
Aug. 1, 1886..	912	266 281	156 606	109 676	41
Nov. 1, 1886..	1 035	321 784	186 745	135 038	42
Feb. 1, 1887..	1 099	311 002	171 051	139 951	45
May 1, 1887..	1 155	324 473	191 439	133 034	41
Aug. 1, 1887..	1 271	460 274	276 164	184 130	40
Nov. 1, 1887..	1 373	452 455	262 424	190 031	42
Feb. 1, 1888..	1 416	729 640	510 748	218 982	30
May 1, 1888..	1 459	552 293	270 964	281 569	51

ENGLEWOOD DISTRIBUTION MAINS.

The amount of water delivered into these mains is measured by a 6-in. meter. The mains are from 4 to 8 ins. in diameter and 4.78 miles long. There are 86 consumers and 40 fire hydrants on this system. The pressure ranges from 25 to 100 lbs. per sq. in.

Quarter Ending.	No. of Consum's.	Da. Delivered to Mains.	Da. Galls. Meas. by Separate Meters.	Daily Balance.	Balance per cent.
Feb. 1, 1888....	70	9 709	3 883	5 836	60
May 1, 1888....	86	17 041	9 543	7 498	44

RIDGEFIELD PIPES.

The amount of water delivered into these mains is measured by a ¾ in. meter. The pipes are wrought-iron, 2 ins. in diameter, 0.40 miles long. There are 17 consumers on this system and no fire hydrants. The pressure ranges from 50 to 100 lbs. per sq. in.

Quarter Ending.	No. of Consumers.	Daily Delivered to Mains.	Daily Gallons measured by separate Meters.	Daily Balance	Balance per cent.
Nov. 1, 1885....	9	1 487	1 322	165	11
Feb. 1, 1886....	11	1 514	1 019	495	32
May 1, 1886....	11	2 551	985	1 366	58
Aug. 1, 1886 ...	12	2 917	1 616	1 301	44
Nov. 1, 1886 ...	14	2 325	2 266	59	2
Feb. 1, 1887....	17	1 647	1 515	82	4
May 1, 1887....	17	1 695	1 534	161	8
Aug. 1, 1887...	17	3 672	3 348	324	9
Nov. 1, 1887....	17	3 037	2 929	108	4
Feb. 1, 1888....	17	3 301	2 968	333	11
May 1, 1888....	17	2 858	2 497	361	14

In addition to the above data Prof. LIBBEY, of the Princeton Water-Works, informs Mr. BRUSH that they have 6 miles of mains on which this balance is 20 per cent., or 20,000 galls. per day. He thinks, however, that the loss is principally due to a leak in the main which he has not yet been able to find, but which he believes he has located within a length of 4,500 ft. on a certain main.

Attention has already been called to the fact that on the 16 miles and more of mains in Hoboken, leakage to the extent of 750,000 galls. per day has actually been checked.

In this connection, Mr. BRUSH also submitted an experiment made to determine the leakage on a 24-in. cast-iron force main laid last year by the Hackensack Water Company. The main is 11 miles long, and at the time of the test, it was supplied with gates, air-cocks and blow-offs, but no hydrants. The main had been carefully examined under heavy pressure for several weeks after the work was completed, and there was no evidence whatever of leakage. It was connected at both ends with the existing 20-in. main. About midway, the 24-in. main was connected with an iron tank at the summit of the whole system. The test was made by opening the gates at each end of the 24-in. main and filling the tank under a pressure of 107 lbs. per sq. in. The gates were then closed and the pressure in the 20-in. main raised to 110 lbs. per sq. in. The loss on this 24-in. main, 11 miles long, was then found by tank measurement after several trials to be about 70,000 galls. per day. The main was composed of excellent castings, with good lead joints, well caulked and laid by experienced men under careful inspection, by day's work. One thing, at least, is true, viz., that serious leaks may exist in a main under heavy pressure and yet not appear on the surface of the ground.

Mr. BRUSH says that perhaps the greatest folly of our time is the almost universal attempt of cities and towns to increase their water supply plant to keep pace with their waste. It is a hopeless task. It amounts to the same thing as attempting to fill a pail which has only a sieve for a bottom. The amount of water that can be used is limited; the amount that can be wasted has no limit. The patience of man has a positive limit, and therefore any amount of water should not be considered as waste, if drawn from a self-closing cock held open by hand—drawn for sprinkling gardens, lawns, roads, side-walks and buildings through a hose held in the hand—drawn for fountains or for use in the various forms of business—but certainly water leaking from street mains, service pipes and fixtures out of order, is useful to none, a damage to the individual consumer, and a serious tax on the community. Flushing pipes and drains from time to time is not waste; but allowing small streams of water to run continuously from partially open faucets and cheap water closets is waste of the most serious character, and if not continually watched and checked will soon reach alarming proportions. Where water has to be pumped, its use as a motive power can scarcely be considered legitimate.

In conclusion Mr. BRUSH acknowledges the assistance rendered to him in the preparation of tables given in this paper by L. L. TRIBUS, a Junior Member of the Am. Soc. C. E.

Plant and Machinery of the Panama Canal.

(*Concluded from page* 124.

Blasting. Besides ordinary drill holes on this Panama work, shaft-blasting is resorted to in cases where the volcanic formation is porous, and the charge liable to "blow out." In the latter case a hole one metre square is usually sunk to a depth of about 10 metres, and at the bottom two drifts are made extending 2 metres each way from the shaft and one metre square. This bottom chamber is then charged with powder and dynamite and a solid plug of cement concrete, extending 5 metres below the surface of the ground, is used to fill the vertical shaft. A number of these shafts are sunk and then fired at one time, with a tremendous shattering effect upon the surrounding area. The shaken mass is then attacked by picks, loaded into buckets and these latter are swung on to cars by portable cranes. In soft rock this has proven the only successful method; but it is expensive owing to the volume of explosive required.

The usual work is done by churn-drills. The ignorant workmen use drills from 6 to 15 ft. long and of various diameters; they receive 25 to 30 cents per lineal metre of holes under 6 or 8 ft., and 30 to 45 cents for holes exceeding 8 ft., according to quality of rock and the labor schedule. These prices include the labor of loading and firing the holes; the cost of material being met by the contractor. A lack of intelligence in the foreman and the cost of transportation seems to explain this substitution of the crudest form of drill for more effective mechanical appliances.

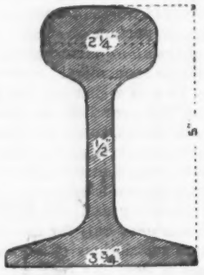


Fig. 1. Panama Co.'s Steel Rail.

Steel Rails.—(Fig. 1). Where the maximum weight is from a French excavator of 36 tons resting on a wheel base of 30 ft. with 2 ft. tie centers, a rail weighing 40 to 55 lbs. per lin. yd. would have been sufficient if properly designed. But the French engineers have made the costly blunder of ordering 120,000 tons of 70-lb. rails of the type shown, in which the depth is entirely too great for the base of the rail. The Belgian locomotives weigh 30 tons, have 3 sets of drivers and a rigid wheel base of 13 ft. The consequence is that on curves of small radius, or over 8°, the over-turning tendency is so great that the rails spread and draw the spikes, causing many derailments of the construction trains. The labor too is much increased in shifting track by the unnecessary weight of the rail adopted.

Locomotives.—The firms represented on the Isthmus are mainly—The *Société Cockerill, Société Belgique, Société Anonyme de Couillet,* the Rogers Locomotive Works and the Baldwin Locomotive Works. The Belgian engines are generally alike in construction and weigh 30 to 40 tons, have 3 sets of driving wheels rigidly connected, the middle drivers being without a flange. They can haul 24 loaded dump cars, weighing 10 tons each, up a 3% grade. They burn about 3 tons of coal a day, and require 1 engineer, at $4.00 to $5.00 per diem., and 3 men at $1.50 to $2.00. The foreign engines are heavier and burn more coal than the American type. The foremen and engineers on the canal prefer the Baldwin engine for rapid work and easy control. The Rogers engines come into this latter category also. The cost of engines delivered at Colon varies from $12,000 to $15,000.

Decauville Cars, Etc.—There are two varieties of the pan-car system of cars, the Decauville and the Baillard types. The latter are box-shape and hold ½ cu. metre. The truck frame is solid iron and carries the wheel-boxes; the body is of iron with semi-circular ends, and it revolves on a grooved track through an angle of 45° They weigh 500 lbs. and cost from $50 to $60 each. The track used has a gauge of 20 in.

The Decauville car is very like the Baillard in the truck construction; but the body of the car is triangular and swings on trunnions resting in a frame fast to the truck. When the car is full, the center of gravity about conforms with the trunnion axis, and the car is easily tipped over. The car capacity is 2½ to 3 cu. metres. The track used is portable, 20 in. gauge, and made in 15 ft. sections with the iron ties fastened to the rails. Mr. WILLIAMS says this plant is not used with mules or horses at Panama; and he often saw the natives in their task work pushing a car to a dump several hundred feet away, when one horse and a train of 6 or 8 cars would have done the work quicker and more economically, as the workmen received 30 cents per cubic metre for filling and pushing these cars.

French stone-breakers were seen at work at Pedro Miguel and at Buhio, of clumsier and more massive construction than similar American machines. The broken stone required for the locks at Buhio, San Pablo, Bas Obispo, Emperador and Paraiso, is all hand-broken, the men receiving $2 per cu. metre for this work. Stone thus broken last year was seen in quantities in a crumbled and disintegrated state from atmospheric effects. In nearly all cases of rock excavation for the locks etc., solid stone is not met with in the upper stratas.

The quarry of the Panama R. R. Co. at Buhio is the only considerable source of stone suitable for masonry and concrete. Mr. WILLIAMS noticed at several points along the line that the piles of broken stone were whitewashed; on enquiring the purpose of this evident care, he was told that it was done to prevent the Jamaican negroes from stealing the broken stone from a neighbor's pile to add to their own, or from a pile already accepted and paid for by the contractor.

Grapplers on Submarine Rockwork.—In connection with submarine mining, "grapplers" are used. These machines are cranes mounted on a boat supplied with a 10 H. P. engine. Attached to this crane are grappling irons operating like a clamshell dredge, which seize upon the broken rock, lift it and drop it into a barge alongside. The boats are 40 ft. long by 18 ft. wide and 6 ft. deep, and have been extensively used in handling the broken coral rock at Colon.

Cranes.—(Fig. 2) A great variety of steam hoisting cranes are used in connection with the rock work at Panama. They are made by J. VOREEZ, Sr., Nantes, 1887; STOTHERT & PITT, Bath, England, and APPLEGATE BROS., London, England. The first named is of the "goose-neck" type and is carried on 4 wheels on a 5 ft. track. The crane complete weighs 10 tons and has a lifting power of 4 tons. The several makes of cranes only differ practically in the manner of conveying power from the engine.

These cranes are used as follows:—The broken rock is loaded by hand into wrought-iron cylindrical buckets, holding ¼ cu. metre each, and for this task workmen receive 20 to 35 cts. per cu. metre. The buckets are then hoisted and swung upon cars and thence carried to the dump. The working capacity of these cranes varies; but at San Pablo and Bas Obispo the average was 9 cars of 6 cu. metres each per day. This is much too small, for with proper handling they should easily accomplish 100 cu. metres per day. The working force is one engineer to each crane, at $3.00 to $5.00 per day, one fireman to 3 cranes, at $2.00 per day, and one carman and one bucketman to each at $1.50 per day. The average coal consumption is ½ ton per day. These machines cost, f. o. b., about $5,000.

Floating Cranes, or Ponton Biques.—At Colon and Panama large floating cranes are used in un-

loading vessels of deep draught that can not run alongside the wharves. The largest type has a lifting capacity of 40,000 lbs. The hull is 60 ft. long by 30 ft. beam and the draught is 10 ft. The derrick forward is 75 ft. in height and has a reach of 30 ft. beyond the sides of the hull. Each crane is managed by five men, including an engineer and fireman. The whole plant is very expensive and it would apparently have been much cheaper to have originally dredged a channel of sufficient depth to the wharf and then to have erected and operated a permanent crane of half the cost.

Marine Cranes.—At Colon there are also seen a number of self-propelling floating cranes with a hold capacity of 500 tons of freight. These cranes discharged from the ship into the hold of the crane boat itself and then steam up and unload at the different shops and warehouses. The lifting capacity of the crane is 10 tons, and there are usually two cranes on each hull. Their use under the conditions at Panama is indispensable to avoid demurrage in unloading a steamer.

Excavators.—(Fig. 3). Many styles of the endless chain bucket excavators are in use, but Mr. WILLIAMS regards the machines made by P. DE MANGE and by Messrs. SATRE, of Lyons, France, as superior to the others. This machine is mounted on two trucks with 4 wheels each, and works on a 5-ft. track. When in operation the base is broadened by jacking up and throwing the weight on the working side on to a third rail 7 ft. from the line rail. The bucket ladder works on an axis on the back of the machine, but throws the center of gravity toward the working side; to offset this, ballast or railroad iron is piled on the extension in the rear of the excavator. The boilers are usually horizontal, with a low center of gravity, and the iron water tank and coal-bunker are placed on the boiler end of the platform.

Two methods are in use for attacking a bank of material; called the "down-digger" when spoil is below the track and "up-digger" when it is above that level. One of the first class working at Tavernilla may be described as follows: The endless bucket chain operates on the "over and under" principle and receives its motion from a square upper tumbler on a shaft carrying a wheel of large circumference gearing with a smaller wheel on the crank-shaft. The buckets are quadrangular with a hemispherical face and no back; the links are hung at the back of the bucket and the ladder is adjustable so as to give a slight contact with the bank and permit the buckets to gradually cut a slice up the bank. The material passes up over the upper tumbler and is then dumped into a hopper, and thence through a shute into cars standing on a second track back of the machine. The engineer on the excavator controls all its movements, including the propelling of the excavator on the track. With good management and an ample supply of dump cars the capacity of this machine is 200 to 300 cars per day, of 6 cu. yds. each. Each excavator requires for its operation: one engineer ($5.00 per day), one foreman ($3.50), one coalman ($2.00), 3 carmen ($2.00 each), one chainman ($2.00).

In addition, each excavator requires the services of two locomotives and 15 to 20 dump cars, depending on the distance to the dump. The coal consumption is three tons per day. In sand and soft clay this machine does efficient work, and in the Culebra cut one of the machines was doing slow work in broken rock.

The Osgood Excavator.—Three of these machines were at work at Culebra and Paraiso, of the seven originally sent out from the United States. The boilers are vertical, 50 H. P., cylinders 10 by 12 in. The buckets hold 2 cu. yds. struck measurement. The cost at Albany, N. Y., f. o. b., is $8,000. The working force required is—One engineer, ($4 to $5 per day,) one dipper tender ($2.50 to $3.50,) one fireman ($1.75), 6 men for shifting truck, carrying water, etc. ($1.50 per day each). The coal consumption is 1½ to 2 tons per day.

This machine is supported on two trucks on a 5 ft. track, and when at work the forward truck is jacked up so as to take the weight off the rails and upon out-riggers of 8 ft. base instead. The excavator weighs 30 tons and is self-propelling. It will excavate a cut up to 70 ft. in width and dump the contents of the digger 29 ft. above the track. Under favorable conditions and in sand and loose gravel as much as 2,000 cu. yds. in a day of 10 hours can be excavated. In hard pan and stiff clay good and satisfactory work has also been done. These Osgood machines were in all cases spoken of in the highest terms by the men on the Isthmus, as doing a larger amount of work with a less force of men and less liability to get out of order than excavators of foreign make.

Up-Digger Excavator.—(Fig. 4). These machines derive their power from the engine either by gear or sprocket wheels. The weight runs as high as 36 tons ready for work; with the dirt in the buckets this weight reaches 50 tons. In the larger types a third rail is placed 7 ft. from the line rail, as in the down digger style, and clamps to the rails are used in both classes. On account of the short length of the ladder the "up-diggers" are limited in their work and the track must be constantly shifted to bring them to the working bank.

The proper supply of dump cars to the excavators of down and up digging types is a most important factor in their working capacity. In the rainy season at Culebra and Tavernilla it was found to be impossible to keep up the tracks, and excavators were abandoned and cranes substituted. The "down-digger", resting as it does on the edge of a slope inclined at an angle of 2 to 1, presents difficulties in keeping its 50 tons of weight from sliding down the slope, a tendency especially aggravated by the vibratory motion imparted to it by the contact of the buckets with the bank. With the "up-digger" the same sliding occurs; and as the ladder is so short that it is often only 10 ft. from the vertical bank, slips often cover the track and stop the machine.

Excavators and Transporters.—(Fig. 5.) At Tavernilla a transporter was used with an excavator of the chain-bucket type. Here a truss 500 ft. long rested with one end on the deck of the excavator and the other, at right angles to the axis of the track, on a traveling derrick and car. This truss was 4½ ft. wide and 10 ft. deep, and an endless belt 3½ ft. wide was put in motion by an independent engine on the excavator. The excavator buckets emptied their contents into the hopper and then on this belt, by which latter it was conveyed to a dump. The outer end of the truss can be elevated 30 ft. from the ground, leaving room for a spoil bank of that height. In the case noted the excavator was digging 30 ft. below the rails, carrying the material 500 ft. and dumping it on a pile 30 ft. high.

To operate this transporter three tracks must be maintained; the excavator tracks, a track for the platform car carrying the engine and boiler for running the belt, and a track for the derrick car at outer end of the truss. The use of this extensive plant is limited to cases of deep cutting when it is necessary to deposit the material some hundreds of feet from the bank, beyond the ultimate slopes. Its usefulness ends with the first wide cut of 30 ft. depth; beyond that depth the spoil must be hauled away in cars.

Dump-Scows or Clapets.—The self-dumping steam

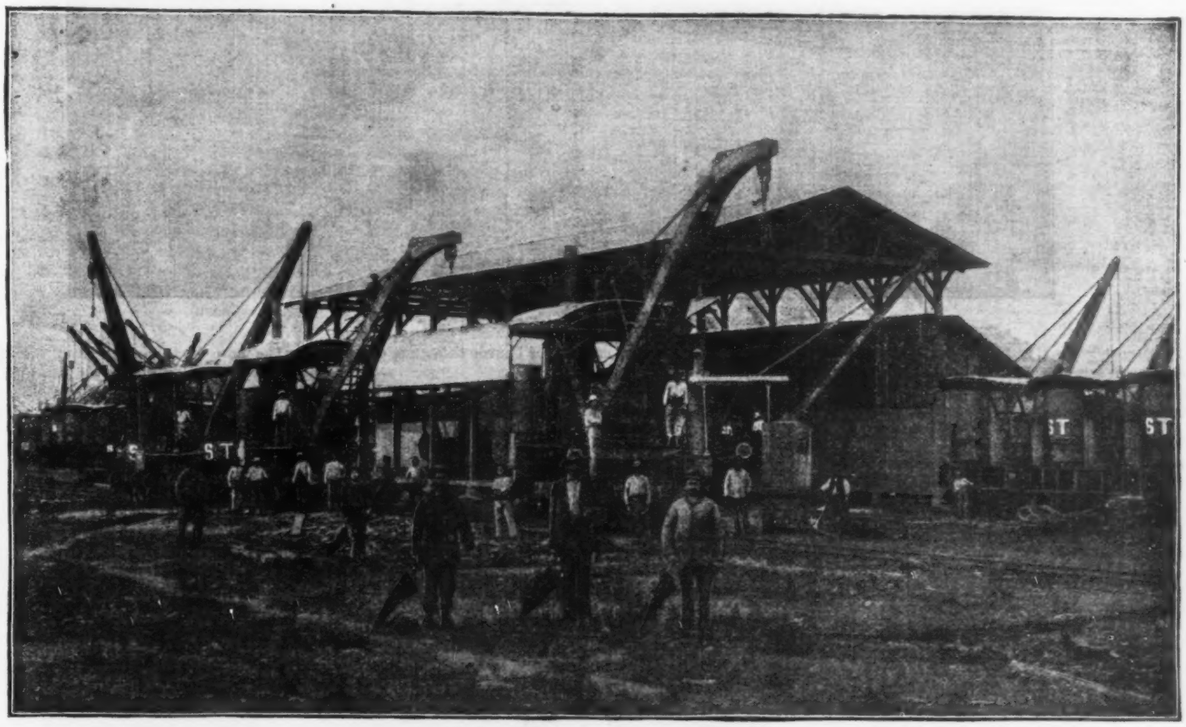


Fig. 2.—French and English Cranes.

scows or *clapets* are all of French construction, made in sections in France and set up in the shops at La Boca and Colon. Their capacity varies from 150 to 300 cu. metres. The hull is from 75 to 120 ft.

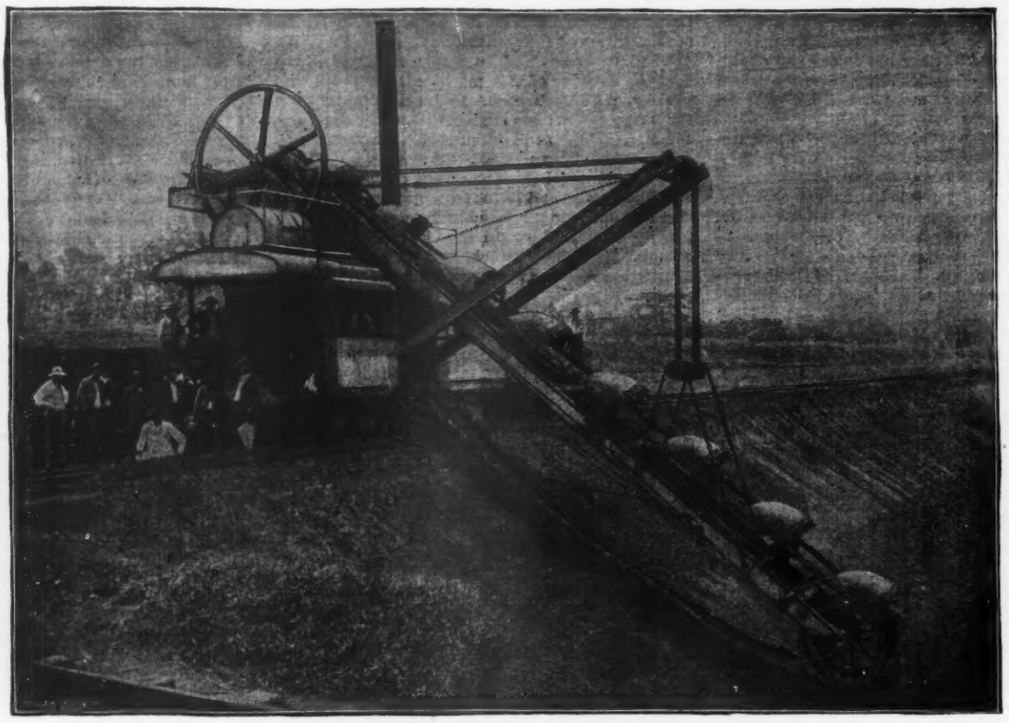


Fig. 3.—French Excavator; "Down-Digger" Type.

long; draught loaded is 10 ft., and they are propelled by twin screws. Each hull is furnished with wells closed by bottom doors operated by chains and hoisting engines. They are easily handled and can be put into position quicker than scows operated by tugs.

These steam scows cost as high as $20,000 con-

structed on the Isthmus. The working force required is: One captain ($200 per month); one mate ($120); one engineer ($120); one cook ($60); two firemen ($50 each); ten deck-hands ($45 each); one donkey-engineer ($45). The contractor boards this gang of men.

Houses for Workmen.—The common type of building along the line of the Panama Canal is to erect a light wooden frame, sheath this horizontally with spruce and roof it with corrugated iron in either round or peaked form. Stationary beds run through the center of this house in rows of two deep, and each house will hold 40 men and is 30 by 50 ft. in its dimensions. The foundations are usually of rough ashlar masonry or concrete in the form of piers, raising the house sufficiently from the ground to permit free circulation of the air beneath. A type called "flying houses" are built of light angle iron frame with corrugated iron sides and roof. These are largely used for machine shops which are temporary in their character and liable to transportation to other sites.

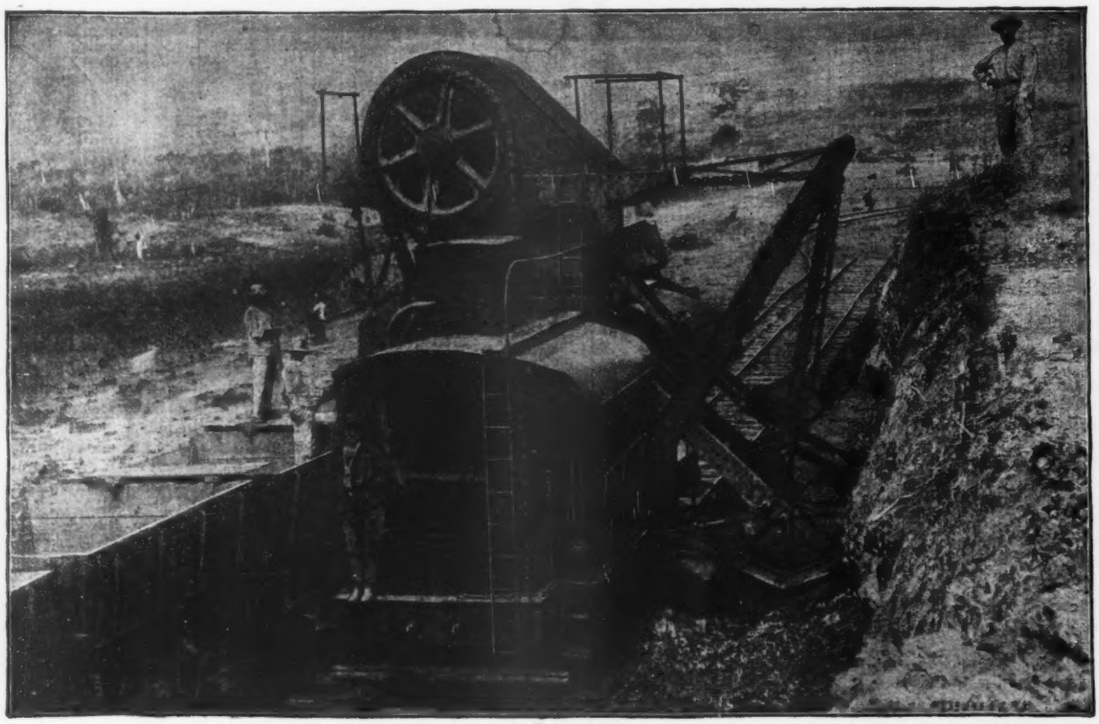


Fig. 4.—French Excavator; "Up-Digger" Type.

Everard System of Dump Cars.—While many wooden dump cars were seen, some built of creosoted wood, the wrought iron body was the only one that resisted the action of the climate. This car body is subjected to the fall of heavy weights from the hopper of the excavators and must be strong to resist the service. The cars here described have 4 wheels running on a 5-ft. track. The axle and frame can be easily taken apart and stowed in a small space. There are two sizes of car body, one for 4 and one for 6 cu. metres. The weight of the larger car unloaded is 5 tons, and double that with the full load of 6 cu. metres of earth. At each end of the body is a hemispherical cam resting vertically on a track on the car frame, so arranged that the car can move through a vertical arc of 45°, 2 men can dump it easily. This system of cars is shown in Figure 6.

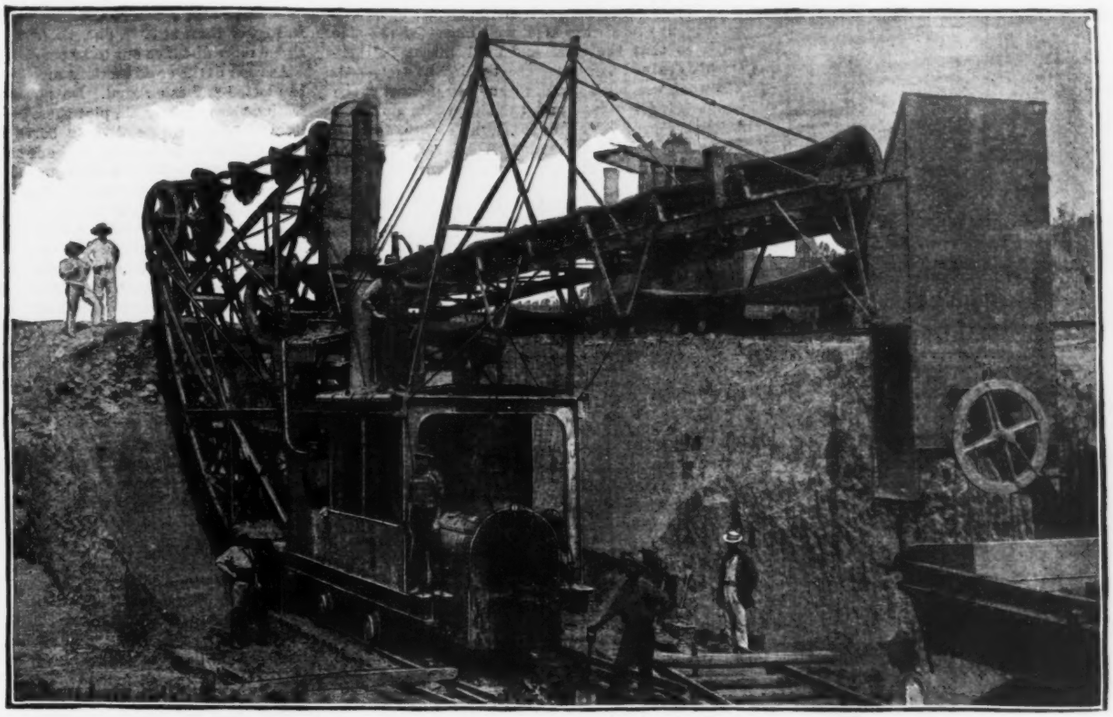


Fig. 5.—Excavator and Transporter; of a Different Type from the One Described.

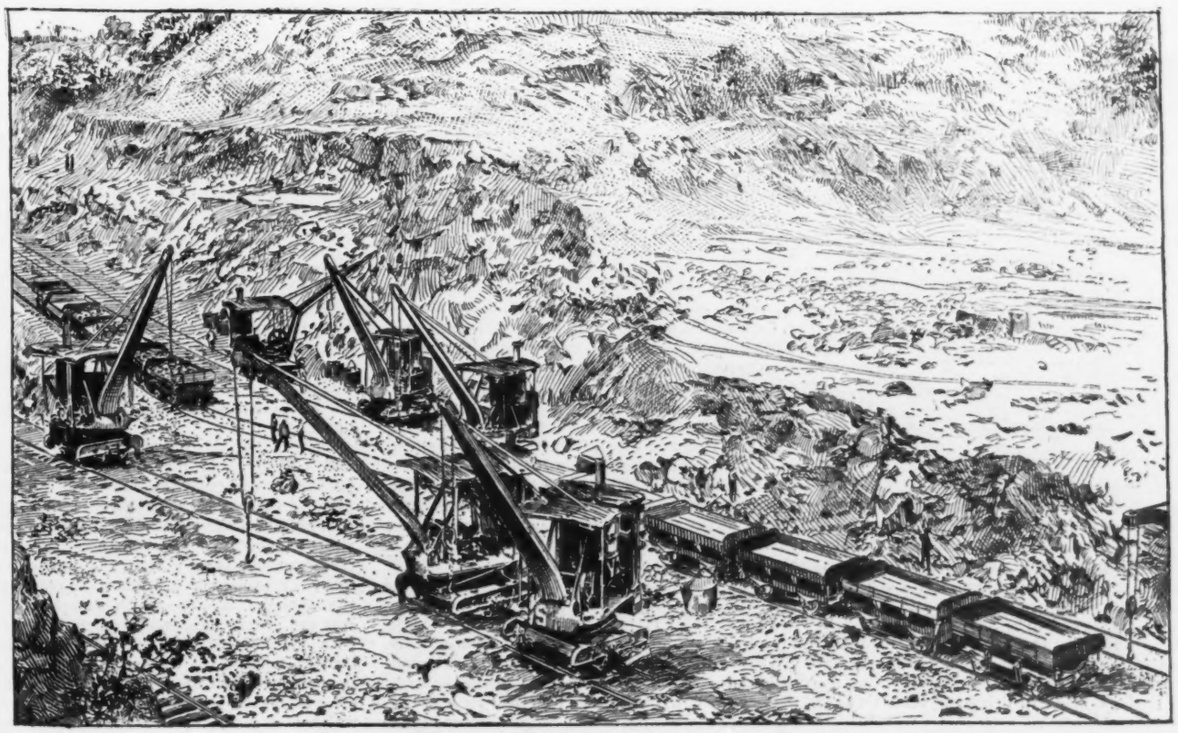


Fig. 6.—Rock Cut at Obispo Everard Dump Cars.

MR. WILLIAMS has avoided greater detail than that here given in describing these machines, as he expects later to give to the American Society of Civil Engineers a separate paper on the Dredging Appliances at Panama, fully illustrating and describing their details. He concludes by saying that the same machinery now in use at Panama could be operated much more effectively and intelligently by American contractors; but the deadly climate of that region forbids the economical employment of any number of skilled white men.

Covered Way as Constructed on the Glasgow City & District Railway.

Mr. WALTER STUART WILSON, M. Inst. C. E., lately read a paper on the above subject before the

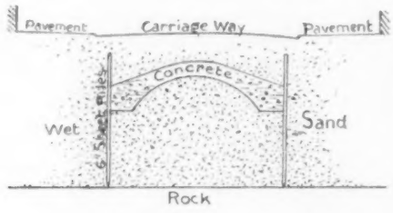


Fig. 1.

Institution that has an interest to American engineers in this day of subway schemes in our larger cities.

The Glasgow City & District Railway is a short line about 2½ miles long made to connect the rail-

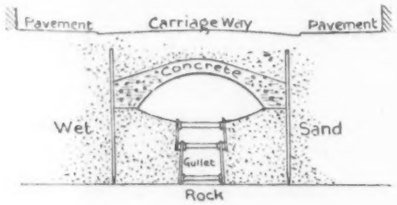


Fig. 2.

ways terminating at College and Stobcross stations in that city. Of its length, 7,800 ft. is in tunnel, and of this length 3,150 ft. were built on the "cut and cover" system here briefly described.

In Kent Road the line follows the street for 2,100

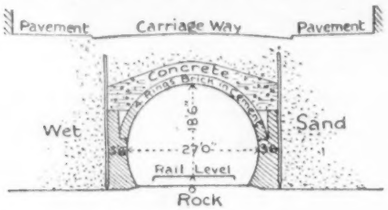


Fig. 3.

ft. in a straight line with a varying depth of 22 to 32 ft. from street surface to rock. All the material above the rock, which is nearly at formation level, is wet sand and mud. To excavate in this material a row of 6-in. sheet piling was first driven at the

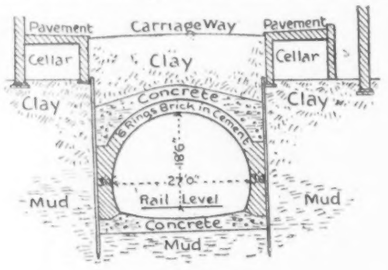


Fig. 4.

back of the proposed walls, at the rate of from 9 to 10 lin. ft. per day for each piling machine.

When a sufficient amount of this piling had been driven the contractor began to sink a trench for the side walls, timbering in the usual way. But when the excavation reached the sewer level a considerable quantity of water was met with. In pumping this water it was found to be impossible to prevent the sand from running through the piling, and this trench-sinking had to be abandoned. As the sewer for permanent drainage was under construction at the time, it was decided to delay the tunnel until the sewer was completed.

Meanwhile, both to insure the safety of adjoining large and valuable buildings and to facilitate after operations, it was decided to form a continuous safety arch of concrete between the two rows of sheet-piling. This was done by removing the surface material to the proper level and form of an arch, and then filling in concrete and restoring the roadway to traffic.

This 2,100 ft of arch was built between April and November of 1884, or in 8 months. In May of 1884, the sewer being available, tunnelling was commenced under the concrete arch from shafts sunk about 150 to 300 ft. apart on cross streets. The gullet (Fig. 2) was always kept well ahead of the side walls so that the sand and mud might be thoroughly drained before the sheet-piling was exposed. The work was pushed rapidly and satisfactorily, the wings being removed and the side walls and arch built at the rate of about 200 ft. per month, and the whole 2,100 ft. was finished in April, 1885. At two points where the bottom was mud a concrete invert was put in.

The figures given explain themselves.

From Preliminary to Track—Points in Railroad Construction for Young Assistant Engineers.

BY MILNOR P. PARET. C. E.

(*Continued from page* 126)

CONSTRUCTION.

About the first work of the party will be to retrace the center line of the permanent location and supply all missing stakes, to hunt up and check the reference points, see if they are right on the ground and correctly noted. Do not change P. C.'s or P. T.'s for a difference of 3 or 4 tenths in distance or a couple of tenths for deflection, wait until the grading is done. Such errors can best be corrected when centers are given for track. It is quite likely that all of the right of way will not have been purchased at the time of beginning the construction, and that further surveys and work of that sort will have to be done. The profile should be re-run and the B.M.'s carefully checked, and additional B. M.'s set at desirable points. Put up tall stakes or signs marking the ends of the sections and mark the cut and fill on the centre line stakes; this is for the information of bidders on the work. Some bidders will not look at the line, a few will walk over it. Next take the cross sections. They need not, except in rare instances, extend beyond the limits of the right of way, and should be taken at every marked change in the ground surface within the limits of the grading. They may at points run only 6 or 8 ft. apart, or there may even be two at the same plus. This refers more particularly to the cuts, they *must* be taken at every station, and also where the side ditch line strikes grades.

The transit and level books will be of the same form as used in location. The B. M.'s may be put in tabular form in the front pages of the *cross-section book*, a good form for which is the following:

Sta.	Grades	Sta. Elvtn.	Grade Elvtn	Cut	Fill	Left	Right.

Care should be used to take the cross-sections on lines quite at right angles to the center line. A good way to record them in the book is in fractional form, the numerator being the elevation and the denominator the distance out.

Do not attempt to cross-section and slope stake at the same time; in case of emergency slope stakes, enough to last the contractors for a month or more, can be set in a day. The slope-stake book will have the same form on first page as the cross-section book; on the second page the slope stake note, also in fractional form with ± sign, takes the place of the cross-section notes.

Grade points on the center line must be picked out and marked with stakes. Slope stakes are set at every station, and in one of two ways; first by carrying an H. I. obtained from a B. M. (To the difference between the H. I. and sub-grade add the rod for fill, and from the difference subtract the rod for cut.) The second method is: Knowing the center cut, simply to take the difference in rods at the center and at the slope stake. Taking an example for illustration: the slopes are 1½ to 1, the half width of road bed 10 feet, the cut at center 10 feet; then if ground were level, the rods would be the same, and the slope stake would read, cut 10 ft., 25 feet out; say the ground rises about 4 ft. in 25, a rod 30 ft. out is 4.2 ft. less than rod at center; or the cutting is 4.2 ft. more; that is 14.2 ft., 1½ times this + the ½ width of road-bed gives distance out, 31.3 ft.; thus with a rod at 32 ft. out, the cut will be, say, 14.6, giving a distance of 31.9; *set the stake*. The rod was taken 32 ft. out instead of 31.3, because, the ground being about .4 ft. higher than at 30 ft. out, there was .4 more cut and .6 more distance out to be considered.

As soon as the cross-sections are taken they should be plotted and calculated. Do not crowd the cross-section sheets too much, plot them beyond the slope line, as there may be slips or borrowing done. A scale of 1 in. = 10 ft. is a good one at which to plot them. Draw in the road-bed and slopes *after* the notes are plotted, in this way sub-grade is plotted as an elevation. It is much quicker than to reduce the elevations to heights from sub-grade as a datum. Put everything in ink on the cross-section sheets, and note the areas, etc., outside of the cross section proper. Have a uniform method of calculating areas to be used by all doing such work. A good way is to start, say at the left hand side, and work to the right of the section, considering the area as made up of a series of trapezoids, of which the parallel sides are the perpendicular distances from sub-grade to ground surface, this will give an excess by the two end triangles which can be calculated separately and deducted from the sum of the area of the trapezoids. Each cross-section should be worked by two separate men; when they do not check, the error can be much more readily found if the same system of calculation is used by all hands. It is well to keep as a record one set of the checked calculations.

It is often difficult for the assistant engineer to locate an error in calculation or other work of that sort; the man who runs the level 10 days before, or the one who copied such and such notes a week before cannot be found; all this sort of thing can be obviated, and the men made to feel a much greater sense of responsibility, if the man getting up the original sheet, or whatever it may be, is compelled to put his initials on it, and also the man who checks it put his initials after the work "checked", and all work of every sort *should be* checked if it be in any way possible.

As soon as the cross-section areas are calculated it is probable that a cross-section estimate will have to be made. It will be after the form of the preliminary estimate on location, except that it is more detailed, and that the known contract prices are used. The grading can be thus arrived at very closely and the probable classification will be better known; the chief engineer will decide on the size of most of the openings, and the kind of masonry to be used in the various structures, the exact width of road-beds, etc.

Some of the remarks on construction yet to follow may be of service in making cross-section estimates. The masonry plans will generally be gotten up by the chief or principal assistant engineer, particularly those of the larger structures; if such be the case, remember that the draughtsman at the Chief's office is quite as prone to fallibility as yourself; with which in mind check over all the dimensions, and sometimes the drawings are a little murky for a boss mason to comprehend. In checking masonry drawings for open bridges, be most particular as to elevations and the distance from bridge seat to base of rail.

Should the assistant engineer get up the plans and submit them for approval, if of an arch, he should construct the line of thrust; this is not difficult as explained by TRAUTWINE. This line should fall within the middle third division of the width of abutment at top of foundation. If great care is exercised in placing the fill, and the masonry is first-class, it is not necessary to keep within the middle third. The bench walls should not be battered on the face, except in the case of arches with high bench walls or at road crossings; it simply contracts the waterway and makes a larger span necessary for an equal area of opening. It is often customary in figuring the proper area of waterway for an arch, only to consider that portion between the top of foundation and the springing line. Arches should always have the preference over open bridges wherever possible. They are generally quite as cheap. If the offset at top of foundation is built neatly and will show its full length, as at most road crossings, such offset may be slightly above

natural ground surface. If the offset is likely to show ragged, as at a stream crossing, it should be about a course below ground or water surface. Unless the foundation be very deep and otherwise expensive, it will be cheaper to lengthen the barrel rather than run up the face walls, owing chiefly to increased masonry in the wings. Slope the back of abutments of arches, and step the back of wings and all bridge abutments and retaining walls. The most economical direction for the wings is of course at right angles to the road overhead. A very pretty effect is made by flaring the wings to an angle of 30° with the axis of the arch. The wing should start from an offset a couple of feet back from the abutment corner, so that the line where the wing joins the face will clear the ring stones. Arches can be built safely with quite a skew and without the spiral form, but the material and quality of workmanship in the arch proper should be of a superior class. If the road be for single track and there be any reason to plan for a second track in the future, it is good economy to build the foundations as high as ground surface for the two tracks.

(TO BE CONTINUED).

CORRESPONDENCE.

Freezing of Water Pipe.

CEDAR RAPIDS, Iowa, Aug. 11, 1888.

EDITOR ENGINEERING NEWS:

In reply to J. F. C. will state that I have a 4-in. cast-iron pipe buried 6 ft. deep on each side of, and crossing a stone culvert, 20 ft. opening. The pipe is first covered with a box of 2-in. lumber, about 8-ins. inside, fitting bell joint, and leaving an air space around the pipe, outside of this is a large box about 30 ins. square; the frame is made of 4 × 6 in. and 2-in. lumber, this is filled with fine sawdust. The boxes are well made of matched lumber and bolted together; they extend about 3 ft. into the earth on each side of the culvert.

The water passing through it is from a direct system of water-works and is taken from the river. The pressure varies from 50 to 100 lbs. per square in., and supplies a railway round (or engine) house machine shops, and the tank. This protection was perfectly satisfactory, during the two winters, 1884-5 and 1885-6. The mercury reached 35° below zero, but the pipe did not freeze. The water was kept in motion by a ball valve in the tank so arranged as to only partially open, and had other constant streams such as to urinals.

But it has since been found that this protection is not sufficient. When the water was not kept in motion, the pipe froze solid, the effect being to force out the lead in the joints and cause a leak. As an additional precaution, I am now trying another air space of 2-ins. around the outer box, and 6-ins. of sawdust in another box around this making two air spaces, and two packed boxes.

It is my intention to make a number of experiments during the coming winter, in protecting water pipes with liquid and other surroundings, and I shall be pleased to hear from others who may be successful in this direction. J. W.

Destructive Force of Colliding Trains.

CINCINNATI, O., Aug. 10, 1888.

EDITOR ENGINEERING NEWS:

Having noted with some interest, your recent discussions regarding the destructive force of colliding trains permit me to express my opinion on the matter.

The energy in the case of a train running at the rate of 60 miles per hour is exactly equal to twice the combined energy of two trains approaching each other at the respective velocity of 30 miles per hour which is shown by the formula.

$$E = W\frac{v^2}{2g} \quad \text{in case of former}$$

and $$E = W\frac{v}{2g}2 \quad \text{" " " latter}$$

giving results as stated above and agreeing with the position taken by you that the destruction in the former case would be to the latter as 2:1.

This would be the result according to theory, but viewing it from a practical standpoint would the result be as above stated?

In my opinion it would not, judging, however, only from observation and personal knowledge.

I would presume that the damage sustained by the train standing still from the train colliding with it at the rate of 60 miles per hour would be much more severe than that sustained by the moving train. Also that the combined destruction to both trains moving 30 miles per hour each, would be much less than in the former case, and about equal to each train.

The basis of my assumption in the first case is that the greatest amount of energy is expended on the stationary train and therefore greater destruction to its matter follows; while in the train moving at the rate of 60 miles per hour, the energy expended in destroying its parts is merely the slight resistance offered by the stationary train plus the reaction from the expended energy on that train.

This is also true of the bullets as per your issue of June 23, 1888, the velocity being much greater however, (2,000 ft. per second to 44 ft. and 88 ft. per second) yet the matter of reaction in my opinion enters largely into this case.

Lead being a non-elastic substance, imparts, in the case of the bullet, its energy to the bullet at rest, and the reaction is not sufficient to flatten the one in motion to the extent that the one at rest is reduced to.

I do not deem the cheese and marble a fair illustration of this problem. I also think that if "G", Scranton, Pa., would use the proper formula, "he would be enabled to see how you arrive at your conclusion theoretically."

As to, "locomotives climbing over each other or plowing under the other", I do not see that this enters into the discussion. It is presumed that the engines and trains are both alike, of the same proportions, in which case there would be no climbing, but more probably "a deadly embrace."

Respectfully, L. C. F.

The Kansas City Exposition Building.

TERRE HAUTE, Ind., Aug. 9, 1888.

EDITOR ENGINEERING NEWS:

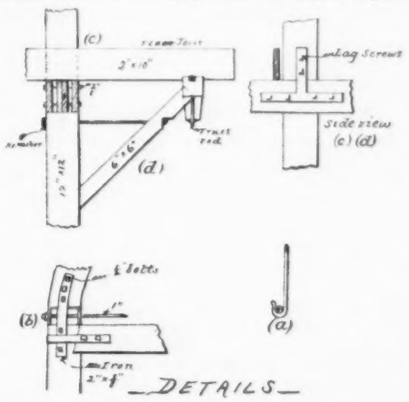
While passing through Kansas City a few weeks since, I jotted down a few notes relative to the Exposition Building. Thinking they may interest some of your readers I enclose a brief summary.

From the cross-section the general design and dimensions can be obtained:

The truss marked (*k*) is composed of wood and iron, the arch being wood and the remainder iron. As near as I could ascertain, there is an iron casting at the points where the web members pass through the arch. The arch pieces are about 7 × 2½ ins., the web rods ⅝ in. round and the tie rod 1 in. round. The web rods are connected with the tie rod, as shown by detail (*a*). Detail (*b*), shows the method of attaching the truss to the upright posts.

The left half of the section, exclusive of the dotted lines, represents the architect's design of the structure, and these trusses, about 15 ft. *c* to *c*, were to support a glass roof and withstand all wind strains, etc.

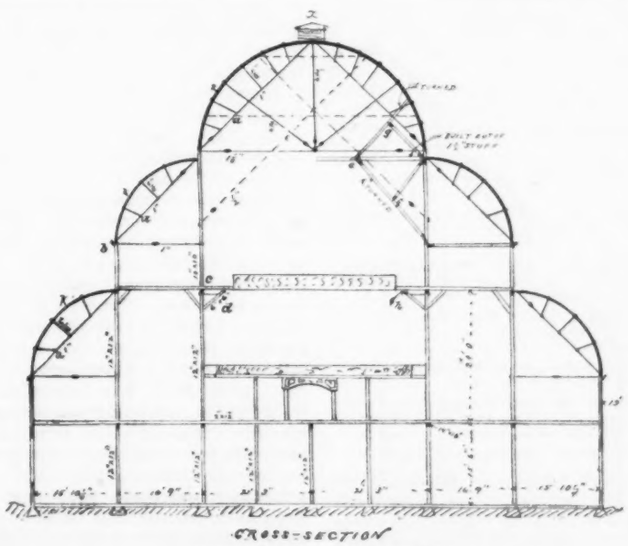
That the design of the trusses is faulty in the extreme, it is hardly necessary to say. If the buildings were symmetrically loaded in a certain manner, and the uprights (*c*) and (*b*) stiff enough to take the thrust of the arches (*k*), then we might expect



Kansas City Exposition Building.

equilibrium to exist without change of shape: but under any other conditions, there would be a change. While the portion (*x*) was being built, the large arch went down at the crown and, as there was nothing to prevent, it went out near the haunches.

When it was discovered that the arches were



Kansas City Exposition Building.

weak, the additional ½-in. round rods, dotted on the section, were put in place, but they were found insufficient—as might have been expected—and now the beams shown on the left are being inserted, not only spoiling the architectural beauty but doing little good, as, with a few exceptions, where ½-in. bolts are used, the connections are made by a strap of iron about 2 × ⅝ ins., secured with lag screws.

The other details given above need no explanation. The evening previous to my visit, during a storm, it was necessary to spread umbrellas to keep off the rain which came through the glass roof.

I noticed many places where the tie rod of the arch (*k*) had buckled enough to entirely clear the hooks of the web members—see (*a*).

In leaving the building I passed down a stairway, having for a side protection a light hand rail, secured at either end by only a nail or two. What would happen in case of a fire?

There are many other points I might call attention to, but I think I have enumerated a sufficient number to show that the Exposition Building at Kansas City is unsafe. M. A. H.

ENGINEERING NEWS

AND AMERICAN RAILWAY JOURNAL

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D. McN. STAUFFER. A. M. WELLINGTON.

EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year*, or 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn. — Regular meeting Sept. 3. Secy. Geo. L. Wilson, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Sept. 18. Secy., S. M. Wickersham. Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Association of North American Railroad Superintendents.—Sex meeting at the Southern hotel, St. Louis, Mo., beginning Sept. 19. Secy., Waterman Stone, Providence, R. I.

American Institute of Mining Engineers.—Next meeting at Buffalo, N. Y.; beginning Oct. 2. Secy., R. W. Raymond, 13 Burling Slip, New York.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 15. Secy., F. R. Hutton, 280 Broadway, New York.

EX-COMPTROLLER ANDREW H. GREEN, in an interview in the Sunday *Sun*, calls renewed attention to the fact that New York City wants more elbow room. London with nearly 5,000,000 people has metropolitan limits of about 690 sq. miles. So New York, with more than 2,500,000 inhabitants within its present area and in its immediate neighborhood, should have legal limits of at least 320 sq. miles. This would absorb the town of West Chester, the whole of Kings County, of Flushing, Newtown and Jamaica in Queens, and all of Richmond county. The boundaries would be water boundaries and the government of such a territory would be more economical than under existing systems.

THE proposed city would have a more symmetrical area than the long drawn out New York of to-day; but to accomplish the end of providing proper facilities for the inevitable spread of population and the proper access to business centers, the city itself must make some concessions and do some work. It must encourage rather than hamper all proper enterprise in the bridging or tunnelling of the two great rivers that now confine it between watery walls; ferries subject to ice and fog delays and with a minimum of speed, will not afford the facilities this new plan demands, and bridges or tunnels, and plenty of them, will alone do away with existing barriers. Mr. GREEN says that within a radius of 25 miles from the Battery, there are more Jerseymen than there are inhabitants in Brooklyn, and more people than in the State of Connecticut. The interests of this population are most intimately connected with New York, and the growth would be even greater, and the interests more beneficial to both if there were some other means of access than by slow ferry-boats. The Hudson must be crossed by trains, which will land the people without delay somewhere near their business. A tunnel may do this, but there are physical difficulties in the way, and always objections to underground travel. Bridges wide enough and high enough not to interfere with navigation, seem to meet the popular demand much better; and engineering science of to-day simply requires capital to meet any such demand with certainty and safety. The general advice of Mr. GREEN is good, and it is wise to plan beforehand for the great metropolis that the near future will see at this point; but we must prepare the way for this advance, and one of the most important of these preparatory steps is to unite the dry land divisions of this future city; not in one but in a number of places. The rest will follow in due time, with the road pointed out.

EIGHT years ago, Central Asia, as represented in and about Bokhara, was as remote for all useful commercial purposes as it was in the days of MARCO POLO; and travel therein was conducted on very much the same leisurely methods as when that illustrious early traveler tells us that "we then reached the city of Bagdad, and we there tarried six years." To-day, Samarkand, the capital of Bokhara and the tomb of TAMERLANE, is within 10 days railway travel of St. Petersburg; and rumor has it that weekly or semi-monthly express trains will soon be in operation reducing this limit to 5 days. This rapid, but quiet and orderly conquest of Central Asia is due to Russian pluck and perseverance, which has in these 8 years tied Samarkand to the Caspian Sea by 900 miles of railway. Beyond short news notes in the daily press, little has been said about this work; yet in prevailing conditions as well as magnitude the task has been one almost if not entirely surpassing the building of any one of our Pacific roads. The engineering difficulties overcome were perhaps not so great as in crossing the backbone of a continent; but the natural obstacles were greater. The country crossed is practically a sandy desert, with stretches of 100 miles absolutely without water; men and materials as well as food and water had to be carried with the construction trains; the only available labor was Persian, and under Russian foremen these natives laid 352 miles of railway in one year, from July, 1885; to prevent the shifting sands of the desert from burying the rails, hardy desert plants had to be encouraged to grow along the line; in fact there was hardly any difficulty conceivable in such a region that was not met with and overcome. The conquest was not entirely bloodless, for the late Gen. SKOBELEFF had to open the way by breaking the power of the Turcomans at Geok-Tekke. But since 1881, Gen. ANNENKOFF, who has been the master-spirit in this railway enterprise, has had little to do save to push the work and to exercise that diplomacy among the native tribes that a Russian so well knows how to make use of. And while the Russian may be feared, he is also respected in these regions, and rumor has it that the natives rather like the conquest; for while the Russian rule is lenient, the railway that they bring opens a profitable market for the good of all parties concerned. With a Russian railway now near the western boundary of China, and Russian engineers rapidly pushing railroad surveys through Southern Siberia, it is difficult to put a limit to Russian ambition, or to foretell the changes the next eight years may make in the political maps of the Central Asian belt.

THE New York *Herald*, of Aug. 20, contains an expensive advertisement in the shape of an "extract" from the last report of M. de LESSEPS to the Panama Canal Company. This "extract" is simply a translation of the expurgated edition of the report sent out to the French press and upon which we commented last week. The information that it does not give is very considerable; and as we have shown, the omissions embrace about everything that gives any clue to the real status of the Canal Company. It is true that this same advertisement promises the report in extenso to anyone who may apply for it "at the company's offices, 46 Rue Caumartin, Paris." But it is hardly probable that the interest in it will prove sufficiently great to cause Americans to send so far for a document that is so ably "extracted" in an American paper. The American end of the Paris Administration would have done better to have saved the money thus uselessly expended in New York, and to have either spent it in Paris where a plaster of this kind would have stopped a leak; or have sent it to Panama, where we fear money will be scarce enough in a few months.

THERE seems to have been either an epidemic of dishonesty among passenger conductors lately, or else a spasm of activity among several railway companies in detecting and suppressing this evil.

The Chicago, Milwaukee & St. Paul, the Union Pacific, the Atchison, Topeka & Santa Fé and the Ohio & Mississippi, are some of the roads which have lately been looking after their passenger revenues somewhat sharply, with the result of discovering a leakage. The Santa Fé and Ohio & Mississippi and some other companies, have been trying the system of train collectors. The question is worth asking, what gain is to be expected from this system? If a higher grade of men are to be employed as collectors than those which have been in service as conductors, they must receive higher salaries, and even with a reasonable reduction in the wages of the conductors, the expense of the work formerly done by conductors alone, will be about doubled. There are few roads which can well afford to divide the duties of fare collecting and the general charge of the train movements between two men.

Again it is not absolutely certain that the "higher grade of men" employed as train collectors will be much more honest than the conductors whom they supplant. But suppose that the higher salaries do secure a grade of men of enough principle not to forget the difference between "mine and thine." Would not the same end be secured by paying higher salaries for the performance of the conductor's duties, weeding out at the same time, of course, the men whose moral status is not up to the mark? It is true that it seems a bad principle to reward the dishonesty of men in any vocation by increasing their compensation; but this is a wrong way of looking at it. What is really to be done is to discard the dishonest men entirely and fill their places with better men who deserve better pay. It

is worth the consideration of the members of the Conductors' Association, whether there is not a chance here for them to greatly strengthen the influene of their association and at the same time do a great service to the corporations which they serve. If they can so unite and govern their members as to be ready to give a guarantee of the honesty of every member of their association, standing ready to make good twice over all losses which may occur through his dishonesty, they will have taken a long step toward placing their order in an impregnable position in the public esteem, and securing the full respect and confidence of their employers.

It would be manifestly improper to refer to this subject, however, without saying that these peculations show the need of more efficient checks on the collectors of passenger revenue. A great step in this direction is the reduction of cash fares to a minimum, and the use of rebate checks which the cash paying passenger returns at a ticket office. Perhaps the Western roads which seem to have had so much trouble, could study Eastern practice in these matters with profitable results.

A NOVEL bid for newspaper subscriptions is that made by the London *Railway Press*. Any subscriber, or casual purchaser, by merely signing in ink a coupon on the cover-page, is insured for £500 in case of death by a railway accident, or death within 3 months after such accident; provided the accident happens within the week for which the casual purchaser holds a copy of the *Press*. This applies to all passenger trains in Great Britain and Ireland and to holders of free passes as well as regular passengers. This looks liberal on its face, and until the periodical has enormously extended its subscription list the doctrine of chance would most probably be in favor of the newspaper. But an odd chance might just as easily occur that would cause deaths enough in one week to bankrupt the concern. The safety of this offer lies in a small list and in the normal carelessness of mankind which will usually permit the weekly coupon to go unsigned.

The New Manual of American Water-Works.

As previously announced, this journal has had in preparation for some time past a Manual of American Water-Works, which is to greatly extend the useful features of the Statistical Tables of American Water-Works issued by us since 1883. While the previous publication was popular and did valuable service, its statistical or tabular form limited the amount of information contained in it, and in some cases necessarily omitted essential and useful items in connection with water supply. It is to cover these deficiencies, and to publish a work more nearly in accord with the importance of the enterprise represented that this first annual number of the new Manual is now in preparation.

The Manual will contain a concise but clear history and statistics of American waterworks, arranged in alphabetical order in a division by States. This description will include the latest estimated population, position of town, history and date of the works, and names of designing and constructing engineers, the present Superintendent and other officials, the source of supply and its character, maker of pumping machinery, the distribution, from reservoir or tank, number of services, taps, meters and hydrants and their makers, the consumption, ordinary and fire pressures, and the financial statement, including cost of works, operating expenses, revenue from consumers and town, hydrant rental, etc. These items are founded on returns filled out and signed by an official of the several companies in the great majority of cases, and corrected to the latest date. We have spent time, trouble and money in the attempt to insure the greatest accuracy possible in such a publication, and any discrepancies that may occur must be charged to the omission of others. Every one at all familiar with such work will appreciate the difficulties and delays that attend the gathering of statistics of this character, and the persistence and patience necessary to accomplish efficient results. But it is in this respect particularly, that our previous experience has served us in good stead, and we do not hesitate to promise reliable and full records.

It will be a work that should be in every water-works establishment in the country; and we mean to insure this desired end by distributing a copy *free* to every superintendent of such works who may have supplied us with the data necessary to make a complete and useful history; and we are happy to state that the exceptions to this rule will be few. This is an expensive undertaking; but our reasons are two-fold. First, it is an inducement, and as we find by experience about the only inducement, that will lead busy, practical men to give the information required. And secondly, to be frank about it, the mere sales of such a work rarely cover the trouble and cost of its proper publication; and to render more valuable the saleable advertising space, we can thus guarantee a specific distribution of the Manual among all the works that these advertisers especially seek to reach. This work is intended for business men, and for business purposes. It has no sentimental value and any such tendency would interfere with its full purpose; which is, to supply exact and valuable information requiring the expenditure of much money and time in its proper preparation, but for which we propose to be paid.

We have been in the field long enough to fully appreciate the task set down, and have bought the experience necessary for the satisfactory accomplishment of this task; and with a plan of campaign that insures the mutual interest of water-works superintendents, the suppliers of materials and ourselves, it seems safe to say that this Manual will be generally satisfactory. This work will be issued each year in a handsome form, with its information extended to cover new works, and corrected to cover the latest additions to older establishments. To its contents such matter will be constantly added, as will appear to have a real and permanent value to those having to do with water-works, with the purpose always in view of covering the whole field of a standard Manual of American Water-Works.

Why is Engineering an Over Crowded Profession?

IN ENGINEERING NEWS of May 12, 1888, the discouragements and trials incident to beginners in the profession were discussed, and reference was made to the fact that, as a rule, the positions in the profession to which an engineer of fair ability may reasonably aspire are, from a financial point of view at least, inferior in returns to those positions which a like amount of honest industry may be expected to gain for one in some other occupations. This is a matter in which every engineer feels the deepest interest. We are all looking for and working for the prizes; and the question of vital importance to every man is: "Have I as good a chance of success in my present work as in any other in which I might engage; and if not, what can I do to better myself?"

We often hear it whispered nowadays that we are training too many young men to be civil engineers. And if we set ourselves to find out the truth or falsity of this, like many another problem which the engineer is called upon to solve, its practical solution seems to vary widely from that which theory indicates.

In theory it appears certain that the great and intricate industrial development of the present day cannot possibly be sustained and advanced unless it is placed in the hands of men thoroughly educated and grounded in the scientific principles on which our industries are based. It seems impossible, with all the prevalent ignorance and incompetence and the omnipresent need of better work and better utilization of means to ends, that there can possibly be an unused surplus of men, well trained, experienced and competent to do good work.

But the practical fact is, that there are quite a number of men, of many years successful experience and thoroughly competent to fill high places, who in slack times find it difficult to keep themselves even partially employed, and whose returns from their work are not at all commensurate with its dignity, responsibility and importance. As for subordinate positions in the profession, even in a season of such great activity as the last, there is not nearly enough work for rodmen, transitmen, and levelers, to begin to satisfy the great number of young men on the lookout for and eager to accept positions of this sort. And if in a year of moderate railway construction, like the present, the applications for "a job" do not greatly increase, it is because a good many men recognize the fact that their chances of securing any branch of engineering employment are very poor, and therefore take up some other occupation.

If we seek for the reason of this plethora of men in the engineering profession, we have not far to go. It is well known that the past half century has seen a revolution in this country in matters educational. In those days there were but three recognized professions: Law, Medicine and Divinity. The only collegiate course of those days was the classical, with a plethora of Greek and Latin, and a great dearth of modern science. Civil Engineering in this country was yet in its infancy; and the only schools where an education in its principles was to be had, were the Troy Polytechnic Institute and the Government Military Academy at West Point. Mechanical Engineering, and Architecture, were quite untouched by the schools, and Electrical Engineering, of course, was beyond the imagination of the most visionary.

We may regret or rejoice, but the fact remains that the past half century, and especially the past score of years, has seen a movement toward the modern and practical as opposed to the ancient and theoretical in education, whose results are far reaching. The great number of technical schools in existence to-day is the best evidence of the strength of this movement. According to the report of the Commissioner of Education, there were, in 1885, in the United States, 105 technical schools with about 15,000 pupils. Thirty of these schools were established between 1875 and 1885. This number is growing every year. The old schools are enlarging their quarters, offering greater attractions, and establishing both advanced courses and schools of manual training. The fortunes that have been set aside by American millionaires to found new schools and increase the capacity of old ones are very great and are rapidly increasing. There was a long time

when the demand, especially in busy years, for competent graduates of technical schools was greater than the existing schools could supply. It cannot be said that this is now the case. Employers of young engineers are no longer hunting for them. But the supply is rapidly increasing, nevertheless; the pendulum is swinging past its normal position.

Again, it is certain that of the various courses of study which our universities offer, there is much to make civil engineering the popular one among the boys who at 17 or 18 are beginning to plan out their future life work. Its aim at direct practical results is in contrast with a certain lack of aim in the "Latin Scientific" or "Partial" courses. The neat instruments and the breezy out-door practice, with a prospect of minor adventure in summer field-work, is much more attractive to the average youth than the dirt and fumes of the laboratory or the oil and overalls of the workshop. Doubtless many engineers owe their first inclination toward the profession to the bewitching glitter of a transit, or a taste of life in camp in pleasant weather. These minor influences are not to be overlooked.

The romance which is connected with the profession in the popular mind is evidenced by the amusing frequency with which the writers of our magazine stories pick out civil engineers for their heroes; and seemingly trivial things like these are apt to have no small influence in directing boys toward the profession. Evidently, all things considered, there is no immediate prospect that the number of students in our civil engineering schools is to lessen.

If we now return to our problem as to whether too many young men are being trained to be civil engineers, the solution of which we thought to vary in theory and in practice, we see that, like many another problem of engineering, the reason for the variation was because our theory was not made to exactly conform to the facts of the case. Instead of an indefinitely great number of engineers being necessary to maintain and extend our railroads and public works, the truth is that there is only employment for a certain number, which it is quite possible may be exceeded by the number of engineers seeking employment; and when this happens, the surplus men must either take subordinate positions, in which their engineering knowledge will be of less account, or take up some other work. In other words, it is likely that of the thousand or so students who graduated this summer from technical schools, a large percentage will not attempt, or if they attempt will not succeed, in finding engineering work. But provided they are not too seriously disappointed in their failure to enter a profession for which they have prepared, and if their education has not been procured at too great a sacrifice, they have no reason to regret that they studied engineering instead of some other course of the college curriculum.

There are too many boys now studying engineering in the schools with the intention of practicing it in the field. There are too few studying it with the same end in view that they have in studying Greek, — the attainment of a liberal education. We pretend to say that the mental culture and discipline of Mechanics, Physics, Dynamics and Descriptive Geometry are quite comparable with that derived from language studies. The classical studies may be more efficient in training the literary powers. The mathematical and scientific are certainly superior in educating and developing the judgment and reasoning faculties. It is because of this that the rapid spread of technical schools is not to be looked on with regret. They will educate men to be successful in many walks of life besides engineering; and we desire and expect no decrease in their number or popularity.

We must accept the fact, however, that this condition tends to keep the lower ranks of the profession full to overflowing and therefore to reduce salaries. Most young men graduating from a course of engineering studies will take a position at the work for which they are in some degree fitted, if they can get it. This pressure on the lower ranks tends to extend upward. The longer a man follows an occupation, the more disadvantageous it is for him to discard it for some new one in which his previous experience is of no benefit. Yet it is only too evident that the prizes of the profession are not very many nor of great value and that their attainment can be hoped for only by the few. Competition among engineers is certainly very strong, especially in times when work is dull. We have frequently referred to the practice of letting out engineering work to the lowest bidder; and we doubt not that necessity leads many to name prices below the real value of their services in order to secure work.

It is a poor critic, however, who points out defects and suggests no remedy therefor; and indeed, the analysis we have already made of the causes that make engineering an overcrowded profession lead us to the remedy at once. Evidently the first remedy lies at the beginning, with the technical schools, which are now practically the only modes of entrance to the profession. Students when they pass their entrance examinations should be plainly told that, great as is the value of the liberal education which they receive in its discipline, culture, and knowledge, they should not expect to put it to use in professional work unless with a full understanding of the fact that the profession offers them hard work and small compensation therefor. It is only kindness to the young graduates, too, to explain to them that if they take up engineering, they will find their path to even moderate success no easy one, and that few can reasonably hope for more. There can be no doubt that a little judicious advice of this tenor from the professors in our engineering schools would be of inestimable value to the young men who each year finish their studies and go out to take up the work of life, as well as to those who are already in the profession.

There is another class of remedies which promise relief in the other direction by increasing the demand for the services of the profession. It should be always borne in mind that in most of the work which an engineer is called on to design and superintend his services are not *necessary*, they are economically profitable. The sick man in employing a physician, or he who engages a lawyer to defend his rights, has more than money at stake. But the man who builds a retaining wall or lays a sewer employs an engineer because without one he would be obliged to expend more labor and material to be sure of good results. Evidently then, every improvement in professional skill which makes possible greater economy increases the value of the profession and the demand for its services. The work of specialization is a movement toward greater efficiency and is therefore to be highly commended. Electricity, Hydraulics, Sanitary work, Bridge and Structural work, Railroad maintenance, etc., are now recognized as special branches of the profession, and are destined to much further development. As every piece of work done with especial care and success is a benefit to the whole profession, so every engineer who makes a botch of his work, injures the reputation of his brethren and deserves their censure.

The work of specialization will tend to increase the prizes open to the profession. Already the highest salaries received by engineers are those paid to specialists of the highest rank. There is one fact, however, to which it is well to call attention. Sticking too closely to purely professional work and study, decreases a man's chances of gaining the desirable positions just outside the profession. In railroading, for instance, there seems to be no reason why a large engineering experience, and a thorough knowledge of all the ins and outs of railroad work should not place civil engineers in the lead as candidates for General Managerships, Presidencies and similar positions in railroad affairs. Yet it is rather uncommon to find civil engineers engaged in any department of railroad work outside their profession. We are very well aware that the positions we refer to are frequently filled with men whose qualifications for the place had little to do with their appointment. At the same time, it is true that there is a demand which is becoming more and more pronounced for men of large ability to manage our railroad lines. Even the President must now be a railroad man rather than a stockbroker, if the owners of the road have their ideas carried out. Such men as the late THOS. J. POTTER, can have their own price for their services. It is because the civil engineer can justly aspire to positions of this sort that we point out their value.

As was stated in our former article, the many opportunities which open to the practicing engineer to engage in business of one sort or another, do much to relieve the overcrowding in the profession. The slackness of work, and the meagre salaries which are becoming the rule, will do much to increase this tendency, and also to deter men from entering the profession. It is to be hoped that this movement may show early results in better pay and more permanent employment for those who stick to purely professional work.

It is sometimes complained that it is impossible for a man to get rich at the profession; but it remains yet to be proven that it is the most desirable thing in life to accumulate a surplus of wealth, and it is certain that the honest and healthful work has very many attractive features which the older professions lack. It is to be remembered, too, that the engineering profession is a thing of recent growth. Modern civilization requires the services of a dozen well-equipped engineers to-day where one was employed a quarter of a century ago. Can we doubt that the extension and improvement of our modes of transportation and communication and the constant accession of luxuries which become necessaries to our domestic life are to give ample scope to the abilities of the next generation of engineers, and are to greatly increase the influence and importance of the profession.

The Handling of Baggage in England and on the Continent.

The London *Railway Press*, of Aug. 3, gives the following allowances for free luggage, if any, in England and on the Continent:

Austria	20 to 50 lbs. free.
Belgium	No free allowance.
France	66 lbs. free.
Holland	No free allowance.
Italy	" "
Switzerland	" "
Germany	About 55 lbs., free on some lines.
Great Britain	1st. class, 120 lbs. free; 2d class 100 lbs.; 3d class, 60 lbs.

In England, luggage is given to a porter, who is told where it is to go, and this porter becomes the agent of the company, and the company is liable for any of his blunders. In Switzerland, all luggage is weighed, and the passenger receives a ticket or receipt for the amount paid and this ticket has on it the destination of the parcel. On arrival the passenger shows his ticket and demands the luggage called for; and if it is not forthcoming, the company is bound to pay on the spot a compensation fixed at

15 frs. per kilogramme, or about $1.37 per pound. In Italy this same system prevails, saving that the rate is 40 cts. per pound. Baggage is seldom lost in either of these countries while in the hands of the railway companies.

Our English contemporary reasonably argues from this that a similar system in England would have equally good results, and that its adoption would soon give much less work to the lost luggage office and enormously benefit the public.

But why not adopt the American instead of the Swiss or Italian half-way methods? Under the system long tested in the United States, about 150 lbs. of baggage are free, though this amount varies on different roads. The passenger leaves his luggage in the proper department at the station, where it is weighed, and excess baggage, if any, is paid for; a brass numbered "check" is then handed to the passenger on showing his passage ticket, which must be previously purchased, and a brass "check" with a duplicate number is securely fastened to the article of baggage by a leather strap. There is no delay, no filling out of paper receipts with weight, amount of tax, destination, etc.; and the brass "check" is less liable to loss than the paper receipt. The presentation of this "check" calls for the delivery of the baggage; but without it the company will not recognize such demand.

Along with a much-needed improvement in the system of handling baggage, in England and on the Continent, our baggage express system would be a revelation to the foreign transportation companies and a decided luxury to the traveling public. There are some difficulties in the way of a service equally efficient with our own, owing to the very different make-up of the trains, and the plentiful supply of cheap cabs at a foreign railway station offsets to a certain extent the necessity for our system of handling baggage. But there are, nevertheless, many cases when it would be a great convenience. English railway companies will transfer your baggage to the station; but while charging for this service, they give the passenger no form of receipt or evidence that they have assumed responsibility for the safety of the package. The traveler must not question their infallibility, until his baggage is lost, and then must patiently wait until the company hunts it up again, if it can. The transporting companies there act as if they were conferring a favor upon the traveler by attending to his baggage at all, and do not go about it in the spirit of an agent who is simply doing his duty in reducing the trouble and anxiety of that public, which has for the time being consigned itself and its effects to the agent and depends upon him for the safety of both.

This English "don't care" method is just the reverse of the American system. With us everything is done to encourage travel and add to the personal comfort of the passenger, from the furnishing of the cars to the care of his baggage. As the train approaches any considerable terminal station, an agent of the baggage-express company passes through the cars; the passenger hands this agent his brass "check," or "checks", if he has more than one, gives the full destination of the baggage, pays for its delivery and receives a receipt which makes the express company responsible for its safe delivery. When the terminus is reached, the passenger need not even look for his baggage; all he has to do is to go home or to his hotel and await there his goods or perhaps find them there on his arrival. These same companies will transfer baggage of any kind from the house to the railways, and in many ways reduce the petty annoyances of travel. It is a pure business transaction, in which service is rendered and paid for, and the agent is held responsible for prompt delivery, or for any loss. There is no assumption of favor conferred and no sentiment about it; and if JOHN BULL would for a moment lay aside his conservative harness, he would find the baggage system of his American cousin very well adapted to his own usually matter-of-fact and unsentimental nature. There is no necessity for a resort to Swiss or Italian methods when a better system has been tested by much longer service in a country nearer akin to England in people and manners.

THE "German-African Lakes Company" is being organized to form and maintain a commercial highway from the African Lakes eastward to the coast. So says a Berlin exchange.

Stray Notes in Boston.

It is nowhere recorded in history that Athens was a foremost city in mechanical industries. The smoke from many factories would have begrimed her classic temples; and the hurry and rush of modern business life would have driven her inhabitants, in their search after "some new thing", to bend their energies toward finding such new things as would enrich the finder with worldly goods. Our own Athens, however, though well famed for intellectual culture, combines with it some renown in commerce and the mechanic arts. A recent brief stay in that city afforded an opportunity of taking a hasty glance at a few of the places in the city noteworthy from the engineer's standpoint; and enough of interest was found to cause the wish that the tour of inspection might have been much more extended.

The Hinckley Locomotive Works are on Albany Street, near the tracks of the Boston & Albany Railroad. Manager CHILD left a busy desk and showed the erecting shop, where the chief feature of interest was a heavy Strong locomotive nearly ready for shipment, built for the Strong Locomotive Company, and certainly a heavy and powerful machine. Instead of a pump attached to the guides, the engine has an independent Worthington steam pump, and has also the Hancock Inspirator. The chief features of this type of engine are the valve and valve motion, which has a single eccentric for backward and forward motion and does not wire draw the steam in the supply ports, the corrugated steel furnaces and welded longitudinal seams of the boiler, and the combustion chamber between the furnaces and the tubes. These have been already made familiar to most engineers by detailed descriptions, and we will not describe them farther. Certainly the type is an interesting one and if, as is claimed, it can be built as cheaply as the usual type of engine, when the details of construction are systematized and the machines are built in large quantities, it may reach a wide popularity.

On one side of this engine were two narrow gauge locomotives for the Northwestern Coal & Navigation Co., which operates a new road in the Northwest Territory, leaving the Canadian Pacific near Medicine Hat. Two American type engines near them were intended for the Alabama Great Southern Railroad. Mr. CHILD reported business quite active for the season of the year.

It was at these shops that the inventor of the famous locomotive with polygonal driving wheels, had his first machine built. The engine is still running in regular service, if we are rightly informed; and it is said that even after the tires are worn down a half inch, the facets are still plainly perceptible, and their beneficial effect (?) upon the tractive power of the engine is still apparent.

The office of the Eames Vacuum Brake Company, on Oliver Street, has some original furnishing which shows up the goods of the company's make very neatly, and is at the same time in very good taste. Pieces of the heavy rubber connecting hose, with nickel plated couplings, are used for gates in the office railing.

The company reports a very brisk business. Their export trade, which is very large, is keeping up well, and their specialty of independent driver brakes is reaching a wide popularity in all parts of the country. The principal advantage claimed over the steam brake is that the engine-driver can vary the intensity of application of the vacuum brake at will, and apply it with any degree of force desired; whereas the steam brake when applied must be put on with its full force. Among the many systems which are using the vacuum brake for their locomotives, are the Grand Trunk, Northern Pacific, Chicago, Rock Island & Pacific, and Chicago & Atlantic.

The Wainwright Manufacturing Company are pushing their specialty of corrugated tubing with great success. Their general offices are now located with the shops at Medford, Mass., but the sales are still made through the branch offices. The principal specialty of which they are now pushing the sale, is a feed water heater for stationary boilers, made with their corrugated tubing. Their expansion joint has been improved and perfected, and its cheapness and simplicity, doing away with stuffing boxes, is bringing it into very extensive use. The company are now perfecting a feed water heater for locomotives, which they hope to have ready for the market in a few weeks. The corrugated tubing used by this company in their feed water heaters is made from seamless drawn brass and copper tubes in which the corrugations are made by special machinery.

It is a noticeable fact that the open street cars seem to have entirely replaced the ordinary ones on the Boston lines for summer use. Certainly in hot weather the former are greatly to be preferred by anyone with an appreciation of pure air. The extra capital required to purchase, maintain and store a double supply of cars, must be very considerable. It would seem that the type of cars which can be easily transformed from open to closed or vice versa deserves in the interests of economy to come into more extensive use.

There may be other railroad eating houses as well managed as that in the Old Colony station in Boston, but the wayfaring man does not find them strewn along his path any too plentifully. Well cooked food, neatly served, with reasonable promptness, seems an easy thing to secure, perhaps, but in how many railroad eating houses is it to be found?

Speaking of the Old Colony, it may not be generally known that it and the Boston & Providence run the trains upon their double track lines left handed. If we are rightly informed, they are the only two railroads in the country which do this. We were informed that the practice was first instituted by them on account of the arrangement of some of the important passenger stations.

PERSONAL.

Col. JAMES E. GRAY, Secretary of the Laflin Powder Co., died at Wilkes Barre, Pa., Aug. 14.

E. P. SMITH, C. E., of New Iberia, La., is reported to have been killed in a fight with negroes at Freetown, La.

W. A. SPROUL, Contracting Agent for the Chicago & Alton Ry., has accepted a similar position with the Western New York & Pennsylvania.

W. H. GRISWOLD has been appointed Superintendent of track of the Tennessee Coal, Iron & Railroad Co., with office at Pratt Mines, Ala.

E. M. REED, Vice President of the New York, New Haven & Hartford R. R., will retire in October, and will withdraw entirely from railway business. He has been connected with the road since 1843.

COL. J. R. SHALER, formerly master of trains on the Memphis & Charleston road, has been appointed Traffic Manager of the Chattanooga, Rome & Columbus Railroad, with headquarters at Rome, Ga.

President SCOTT, of the Colorado Midland R. R., will perform the duties of General Manager, in place of D. B. ROBINSON, who has resigned that position.

W. W. STARR, of Augusta, Ga., Superintendent of the Port Royal & Western No. Carolina R. R., has been appointed Superintendent of the Southwestern division of the Georgia Central system, with headquarters at Macon, Ga.

C. E. BOWDITCH, C. E., of Boston, Mass., has been engaged by the Sewer Commissioners of Northampton, Mass., to investigate and report upon the sewerage system.

F. S. GUTHRIE has been appointed Chief Train Dispatcher of the St. Louis division of the Louisville & Nashville R. R., and T. W. WILDE has been appointed Master of Trains on the same division.

THE attention of Civil Engineers and Draughtsmen is especially invited to the advertisement of B. C. CARD, Dep. Q. M. Gen. U. S. A., which is published on the front cover page this week.

A. J. MCCABE, who for years has been train dispatcher of the Montana division of the Northern Pacific, has, by the removal of J. M. GRAHAM to superintend construction in the Red River valley, been promoted to the position of Acting Superintendent of the division.

J. F. O'BRIEN, who recently resigned his position as Superintendent of the Mahoning division of the New York, Pennsylvania & Ohio R. R., has gone to Mexico as General Manager of the Mexican National Railroad.

ROBERT LAW, formerly Division Superintendent, has been appointed Manager of a new division of the Northern Pacific R. R., extending west from Billings, Mont.

W. B. MICHIE has been appointed Assistant Engineer of the St. Louis & San Francisco Ry. and assigned to duty on the construction of the Red River bridge at Arthur City, Tex.

W. K. MORLEY, Superintendent of Telegraph, of the Chicago & Alton Railway, has been appointed Superintendent of the Kansas City Division of the Chicago & Alton, with headquarters at Roodhouse, Ill., to succeed S. D. REEVER, resigned. The appointment will take effect Sept. 1.

GEORGE E. MERCHANT, General Manager of the Western New York & Pennsylvania Ry., has resigned his position, which he has held for the past seven years, to assume the Presidency of the Rochester & Pittsburg Coal & Iron Company. Vice President BALDWIN will continue to discharge the duties of his present position, and will, in addition assume those of General Manager.

GOUVERNEUR MORRIS died on August 20 at his residence at Bartow-on-the Sound, aged 75 years. He was the son of GOUVERNEUR MORRIS of Revolutionary times, prominent in political affairs, Minister to France in 1789–94, and later one of the most earnest promoters of canals in his native State. The younger Mr. MORRIS was very early connected with railway affairs, from the days of the Harlem R. R. in 1838; and he only retired in 1880 from the Presidency of the Vermont Valley R. R. During his busy life he was President of the Erie, the New York Central and the Harlem railroads, and one of the founders of the Illinois Central and the Iowa system.

PUBLICATIONS RECEIVED.

Irrigation in the United States.—Its Extent and Methods, with Digest of Laws Governing Water Supply.—A Report prepared by RICHARD J. HINTON, under the direction of the Commissioner of Agriculture. 240 pp., 9 sketch maps, etc. Issued by the U. S. Department of Agriculture, Washington, D. C.

This report is one of the latest publications on this subject, and is of especial importance from the fact that it deals with the present condition of irrigation in this country and shows, by letters from landowners, engineers, farmers, officers of irrigating companies, and others, the extent and nature of the works, the results obtained, the increase in land values, the products of the land, the effects of irrigation on health, fertility of soil, etc., the climatic conditions, etc., etc., while the letters contain much general information and many important suggestions. The report commences with a general description of the arid region, which is considered in three general divisions; (1) the plains region, running north and south from British America to the Rio Grande valley in Texas, and east and west from the 100° to 105° W. longitude; (2) the arid district, extending from British America to Mexico, and from the foothills of the Rockies to the foot-hills of the Sierra Nevada in California; (3) the Pacific coast region. Each of these divisions is considered in detail, describing the several streams, valleys, ranges and plains, the nature and products of the country, altidude, rainfall, etc., and the irrigation systems of water supply by canals or artesian wells. The legal issues involved in the conservation and distribution of water for economic uses are also discussed. Also the methods of distributing the water from canals to different farmers in proper quantities according to their acreage and water rights. There is a very interesting descriptive table, showing the strata, piping, etc., of wells in Arizona, that have been put down by railway companies. A careful summary is given of the water and irrigation laws of the several States and Territories; also those of Mexico, France, Spain, Italy and ancient Rome. An Australian report on American irrigation is given as an appendix, and there are some 10 sketch maps of irrigation districts, etc.

This work is issued at an opportune time, and, as before stated, is of special value as it deals very fully with the condition and practice of this country, giving information never before brought together to form a complete treatise on irrigation in America; parties interested having hitherto to be satisfied mainly with separate and individual papers, reports, etc.,and foreign works on irrigation.

Code of Rules Governing the Condition of and Repairs to Freight Cars for the Interchange of Traffic.—This is a pamphlet giving the rules, adopted by the Master Car Builders' Association, and revised at the meeting at Alexandria Bay, N. Y., in June, 1888. There are diagrams, and forms and also a list of companies which have adopted the rules. The pamphlet is in very handy form. It is published by the Association, 45 Broadway, New York.

Transactions of the American Society of Civil Engineers, February 1888. Contents: An Investigation to Determine the Strains in a Hollow Cast-Iron Disk Cooled from the Interior; by G. LEVERICH. Description of the Work of Constructing a Dam across the Potomac River, for Increasing the Water Supply of Washington, D. C.; by SAMUEL H. CHITTENDEN. An Automatic Waste Weir; by A. D. FOOTE. Notes on the Classification of Railroad Accounts and the Analysis of Railroad Rates; by G. MORDECAI.

Report of Proceedings of the Association of Dominion Land Surveyors, at the 5th Annual Meeting, held at Ottawa, March 15 and 16, 1888. Price 50 cts. Address Mr. ARTHUR O. WHEELER, D. L. S., Secretary and Treasurer, Ottawa, Canada.

This annual report of a young but exceedingly active association, aside from the constitution and by-laws, and the formal minutes of the last meeting, contains a number of excellent papers on subjects of interest to the surveying fraternity. We will here give these by title only, as follows: Memorandum on Geodetic Survey, by a committee appointed to consider and draft a scheme for the trigonometrical survey of the Dominion; Suggestions on Geographical Nomenclature in Canada, Dr. G. M. DAWSON, Geographical Survey; The Yukon River and its Sources, WM. OGILVIE, and a discussion; The Placing of Permanent Marks in the Field as a Means to Preserve the Information afforded by Public Surveys, S. L. BRABAZON; To find the Radius of Curvature of the Meridian, and of the Great Circle Perpendicular to it; British Government Surveys, I. G. BOULTON, R. N.; Natural History in Connection with Topographical Surveys, JOHN MACOUN; Brief Directions for Preparing Skins of Small Mammals, Dr. C. HART MERRIAM; Map Making, J. H. BROWNLEE; The Mining Industry of the Province of British Columbia, Past and Present, THOMAS DRUMMOND; and Relations between Master and Man on a Survey Party, Regulations for the Government of Survey Parties in the Field, JOHN MCAVEE; Methods of Determining Geographical Positions, W. F. KING; Electrical Apparatus in the Determination of Longitude, OTTO J. KLOTZ; Ranching and Irrigation in British Columbia, THOMAS FAWCETT.

Transactions of the American Institute of Electrical Engineers.—Special meeting of April 14, 1888. Subject, "Maximum Efficiency of Incandescent Lamps", by JOHN W. HOWELL, with discussion. Also 19 pages of the Index of Current Electrical Literature. Price 50 cts.

The Institute has begun in its monthly issue of Transactions, an Index of Current Electrical Literature, dating from October. The permanent value of such an index to electricians and the scientific public is apparent, and the present installment contains references to more than 300 distinct articles, cited from 18 papers and periodicals which are regularly indexed each issue, and from about 50 journals in all. Subsequent issues will comprise the leading electrical publications in foreign languages. A standing list of these periodicals, with publication address, price etc., will also be printed when space permits.

Influence of Aluminum on Cast-Iron.

Mr. W. J KEEP, in his paper on the above subject at the Cleveland meeting of the Am. Assoc. for the Advancement of Science, gives the results of his experiments which may be condensed as follows (1) The addition of $\frac{1}{10}$ of one per cent. of aluminum to white iron increased its strength 44 per cent., and made a perfectly solid casting. (2) Six tests showed that aluminum added to melted iron remained in the iron in the proportions originally added. (3) Aluminum changes white iron to gray, or causes the combined carbon to take the graphitic form.

(4) It takes away the tendency to chill by causing the carbon to be turned to graphite before it can be caught in the combined form when in contact with a body that withdraws the heat. (5) It lessens the thickness of the sand scale and the iron can be cut easier. (6) It increases the strength of the iron under a load gradually applied as well as the resistance to a sudden blow; due probably to the soundness of the casting. (7) The compactness of grain and increase in graphite increases the elasticity when aluminum is used. (8) For the same reason permanent set is reduced.

(9) The sudden change of the combined carbon to the graphitic form, by the use of aluminum, causes a swell at the instant the metal becomes solid by reason of the increased space occupied by the graphite; and on cooling the iron will shrink less. (10) Tests show that aluminum added to iron low in silicon increases fluidity; but that as the silicon increases, aluminum does not add to the fluidity but tends nevertheless to produced sharp castings. Mr. KEEP supplements this paper by another giving the chemical proof of the correctness of these general statements.

THE latest bit of Western enterprise is the completion of a wagon road to the top of Pike's Peak in Colorado. As this peak of the Rocky Mountains is over 14,000 ft. above the sea level, this is probably the highest carriage way in the world. It has been opened by private enterprise as a toll road and the inducements are the magnificent views afforded at almost every turn in the way. The road has no grades exceeding 10 per cent, and is 14 ft. wide and surfaced with gravel.

THE Reading Terminal project in Philadelphia has met an obstacle now over the vexed question, which we have lately discussed in these columns, of who shall pay for the removal of the grade crossing. The Philadelphians seem to be well united on one point; that the franchise for the new terminals shall not be granted until the company consents to some arrangement for the removal of the grade crossings. To this the company replies that its surface tracks are more necessary to the manufacturers along their line than to anyone else, and that their interest must be consulted to some extent. At the same time, it acknowledges the importance of removing the surface tracks and professes its willingness to do so if the other parties interested, the city and the street railway companies, will bear the expense. No one seems to be yet ready to furnish the $3,000,000 or so required to remove the 67 grade crossings which now exist on the Reading lines in Philadelphia, and until this question is settled, progress seems to be effectually blocked. The Reading company is rather excusable for its unwillingness to sink capital in removing grade crossings just at this time when it is only emerging from financial impotence. But doubtless it will do its share, if the other parties come up to the mark.

SOCIETY PROCEEDINGS.

New England Roadmasters' Association.—*Sixth Annual Convention.*—*(Concluded).* In the report of the business session in last week's issue, the list of new members elected was omitted. They were as follows: A. C. STICKNEY, (Boston & Maine—Mass. Cen.); WM. HUTCHINSON, (Boston & Maine—Boston & Lowell); T. J. DICKEY, (Fitchburg), W. T. MOSHER, (Boston & Albany), J. F. KEENAN, (Hartford & Conn. Western), and C. B. LENTELL, (Boston & Albany).

After the business was disposed of, the Association took up the subject of highway crossings, the best form for economy safety and efficiency. W. E. CLARK, (Vt. Valley), a member of the committee appointed to report on this subject, said he used at crossings where travel is heavy, a guard-rail inside the main rail, curved at each end, leaving a flange way 3 ins. wide. The space between the guard rails is paved with stone. A crossing like this has been in steady use for 8 years at Bellows Falls, Vt., and carries a very heavy traffic. The cost, and cost of maintenance for the 8 years has been $75. A similarly situated crossing made with plank, cost to build and maintain for 8 years $514.68. This makes a saving in favor of the rail and paved crossing of about $55 per year.

S. B. BODWELL, (Boston & Maine) said: No one rule can be made to fit all crossings. The sort of crossing to be used depends on the location, whether in the city or country, and the amount of travel to which it is subjected. I find a good way to make a crossing where there is heavy travel is to lay it like a street railway track. Lay a 12-in. wide timber beneath the rail and spike a hard wood block on the inside close up to the rail with the side next to the rail bevelled off for a flangeway. Between these hard wood guards pave as usual.

A. C. STEVENS, (Boston & Maine): I used a similar stick for a flangeway, but so many horses caught their shoes there that I had to take it out.

W. E. CLARK. I had the same trouble until I widened my flangeway to 3 ins. There were continual complaints before, and I thought I would have to give up the use of the guard rail. Mr. HYLAND, (Cheshire) advised me to widen the flangeway, and I did so, since then not a horse has lost a shoe there. Mr. HYLAND has had a similar crossing in use at Keene, N. H., for 15 years with 2½ in. flangeway, and states that it has never given a particle of trouble to horses.

Some members expressed themselves in regard to the stone blocks being a possible source of danger from heaving up enough to be struck by the pilot, but those who were using stone paved crossings had had or expected no trouble from that source.

R. HYLAND (Cheshire) said he had used stone chips from quarries for filling beneath crossings, and found them to give very good drainage. He used no carpenters in laying crossings. The trackmen could handle tools well enough, and were more expeditious, without being over nice like a carpenter.

W. F. ELLIS (Providence & Worcester) said: I find it economy to take a carpenter and helper from the bridge gang when there is a large crossing to be laid. They can saw and hew with much less waste of material and time than trackmen, and have proper tools for the work, which trackmen have not. I use oak plank for crossings. The chestnut plank we get are often second growth timber and are soft and spongy.

President LANE (New York, New Haven & Hartford) said: We have crossings on rock, on gravel and on clay. On rock ballast we now use 3½ in. yellow pine plank. On all important crossings we fill the space between the rails full, and adze off a space 3½ ins. wide next to the ra

just deep enough for a flangeway. One thing in favor of this form of crossing is that it frees itself from snow and ice in winter, and there is no picking ice out of a deep and narrow flangeway. We are now using yellow pine over the whole of the Consolidated system for crossing planks. I greatly prefer oak, however. Pine wears very fast where there is much travel. I think it has not over half the durability of oak. I have tried an iron guard rail, and it is certainly a great saving in expense of maintenance; but I had to take it out on account of the horses, which lost their shoes or were thrown by it. The flangeway was 2 ins. I never tried a wider flangeway. On our rock ballasted line I never knew of very serious trouble from the heaving of crossings. (In answer to a question) I think it might be a good idea on gravel ballasted roads to put in rock ballast at the crossings, and far enough each side to give it good drainage.

F. M. CLARKE, (Housatonic.) While I was on the Consolidated road we had some crossings in clay soil which gave much trouble by heaving. I dug those crossings out to a depth of about two feet beneath the tie and filled in with a layer of cobblestones at the bottom, then a layer of cinders, then a layer of gravel. These never troubled us afterward by heaving. I am doing the same on the Housatonic now.

J. W. SHANKS, (New London, Conn.) Was it stone, cinders or gravel that kept the crossing from heaving?

Mr. CLARK. It is no single thing in a man's life that makes a man of him. (In answer to question) I dug out and filled in 6 to 8 ft. each way beyond the end of the crossing.

The discussion on these points continued for some time, the main points brought out being that in putting a crossing in good condition by filling in rock ballast, it was well to go to some distance each side of the crossing and to make the ballast filling as wide as the top of the subgrade, so that water would drain off; 1½ to 2 ft. was deemed a sufficient depth to go down, though one member dug down as deep as 4 ft. In this case, however, the crossing was so much more solid than the rest of the track that it gave trouble. Cinders were recommended as the best possible material for keeping frost either in or out.

The following resolution was presented:—*Resolved*: That for highway crossings where there is much travel, white oak plank should be used of such width as to need no hewing or trimming, and that the crossing should be drained and ballasted. An amendment to add an iron guard rail, placed on its side, with its base vertical and snug against the inside planking, was lost, as was also one to add the iron guard rail described by Mr. CLARK, and the original motion was carried.

A letter was read from JAS. T. FURBER, General Manager of the Boston & Maine, extending to the association an invitation to take a trip over some part of the Boston & Maine system, at the close of the Convention. A resolution of thanks for the courtesy was adopted.

The next subject for discussion was steel rail, proper weight and section, character of inspection before purchase, manner of unloading and whether or no it should be curved before laying.

E. NEWCOMB (Portland & Ogdensburgh) presented for the Committee appointed to consider this subject, the following recommendation: That steel rail should be of a weight of not less than 72 lbs. per yd. The section should be 4½ ins. high by 5 ins. base, with a round head. Rails should be carefully inspected before acceptance, should be unloaded from cars so as not to injure them, and should be curved before laying. For joints the broken joint is recommended for well ballasted, single track roads.

The first question taken up was the proper form of section. Mr. W. F. ELLIS showed a section, with the joint, of the rail now adopted as standard on the Providence & Worcester. The principal feature of the rail is the head, the top of which is a flat curve. The corners have ½-in. radius and the sides incline inward ⅛ in., in which it differs from all other rails now in use in this country. The fishing angle is 20°. The section has a 4½-in. base and is 4¾ ins. high. Quite a large amount of this rail is now in use on the Providence & Worcester and gives excellent satisfaction. In its general form this rail is an exponent of the principles laid down in recent editorial articles in this journal, and the practical success of the section on a very crooked road bears out well the theory of rail wear which was then stated. In discussing this section, the members, with the exception of Mr. ELLIS, were united in condemning the rounded top, and the inwardly sloped sides of the head. They wanted a rail to fit the wheel flange as nearly as possible, and were all of the opinion that a vertical or inwardly sloped side would be productive of sharp flanges at once. Another generally expressed opinion was that the rail was too high and had too narrow a base. There was much favor shown to the idea that the worst fault of the present sections was the way they cut into the ties under heavy traffic. The proportion of 5 ins. base to 4 ins. height met with much commendation. The subject was still under discussion when the adjournment was taken.

Most of the evening session was spent listening to an exposition of the merits of the various articles on exhibition. The Sheffield Velocipede Car Co., was represented by J. N. BEASON and F. A. MCARTHUR, and showed a model of their standard hand car, which seems to have obtained a good foot-hold among New England roadmasters. The Kalamazoo R. R. Velocipede & Car Co. was represented by its President, G. W. MILLER, and showed one of their standard section cars with combination paper and steel wheels. The Dunham Mfg. Co., were represented by GEO. H. BRYANT, and showed the Servis tie plate, which was afterward discussed by the Convention. Pettibone, Mulliken & Co., of Chicago were represented by B. B. KERR, and showed the Perfection and Union track drills, the Alkin forged steel rail brace, and the Monitor iron switch lamps. A drill and track jack made by ANDREW WARREN of St. Louis were also on exhibition.

Manning, Maxwell & Moore, by JAS. B. BRADY, showed Smith's portable rail saw; and the Higley Sawing & Drilling Machine Company, of Boston, showed a new rotary rail saw, recently invented and not yet ready for the market. The novel feature of this machine is the application of the power to the rotary cutter. This is driven by pins on two opposite gears which work in holes near the circumference of the saw; a principle which the inventor thinks will be of wide value in permitting the use of milling machine cutters of a larger diameter than has hitherto been possible.

The well known Bush interlocking bolts were shown by C. P. WILLSHAW. In nutlocks the Excelsior single and double, made by Ruffner, Dunn & Co., were shown by D. B. RUFFNER. The Wilcox Split Bolt & Nut Retainer Co., of Chicago, also had its goods on exhibition.

Mr. GEO. W. PARSONS of the Pennsylvania Steel Co. was present with drawings and descriptions of the newest devices offered by the company in switch stands, spring frogs, three throw point switches, etc. JOHN GREEN of Fitchburg, Mass., showed his newly invented yard frog, for which great durability was claimed. A model of a new thing in switches was shown by its inventor, J. B. SUFFERN, of Hillburn, N. Y. It consists of an attachment to the ordinary point switch, making it automatic for trains on the main line facing the switch as well as those trailing it.

The technical discussions of the Convention were resumed at 9 P. M. Mr. ELLIS explained farther the advantages of the type of rail section before referred to, and then spoke on the subject of rail inspection. He said there was great need of some better knowledge of the materials which we purchase in rails than now exists. Some old 60-lb. rails in his track were more valuable in the years of service that they gave than some of the new 72-lb. rails promised to be. Steel rails now-a-days were apt to show soft spots, and occasionally a tendency to split in two along the center of the head. If there is no method of determining whether a steel rail is good or poor after manufacture, then let the manufacturer be made to furnish good material by putting in every contract a guarantee that each rail shall wear so many years without showing soft spots or structural defects. The point which roadmasters could and should inspect however was surface and line. In a recent purchase of steel, he kept two of his best foremen at the mills until every rail was loaded, and not a rail went on the cars without their approval. The same mill sold a large order to the New York & New England at about the same time, and it was said that 40 car loads had to be returned to the mill to be straightened. Every railroad can save much time and money by having their rails inspected at the mills.

Mr. PATCH. I have inspected at the mill all rails delivered to our road for the past 16 years. Rail straightening at the mills is done by contract. A man gets so much per ton, and it is an object for him to turn out as many tons as possible each day. I inspected a lot of rails at one time turned out the day after the hands had been on a picnic, and in one forenoon I threw out over 400 crooked rails. I also believe that railroad companies should put the work of rail inspection in the hands of men in their own employ. I know there are men who make a business of inspecting rails for railway companies at so much per ton. I happened to be at a mill where rails were being shipped to a railway company who employed one of these inspectors to pass upon their rails. The way this man inspected them was by sub-letting the work of inspection to one of the rolling mill workmen (whose wages were a dollar and a half a day) for 25 cents a day. Many rails were being put on the cars which I would never accept.

President LANE: A while ago we bought a lot of crooked steel and I set a gang of men at work to straighten it. After a few days I ascertained how much it was costing us per ton to get it in a shape fit to put it on the track, and reported to the Superintendent. As a result, the purchasing agent sent for the manager of the rolling mill, and he was obliged to confess when he came to look at the rails, that they should not have been delivered in such a condition. The result is that we now inspect all our rails at the mill. A railroad company cannot pay for a straight rail and then pay $2 to $5 per ton to have them straightened before laying.

The question of unloading rails then came up, and several members gave their practice and opinions. While many followed the practice of unloading from the side of the car, letting the rails drop to the ground, others were convinced that it was a good idea to unload from the end of the car, putting part of the gang on the car and the others on the ground, handling the rails with tongs, of which tool Mr. ELLIS described a convenient form. Others followed the practice of piling the steel when taken from the train, and scattering it where wanted afterward with a push car. This discussion closed the evening session.

THURSDAY, AUG. 16.

The morning session opened with a discussion of the subject of rail joints, suspended or supported, and square or broken. Mr. PATCH said that for a single track road he would have joints supported and broken. On a double track, however, creeping must be avoided, and it is then better to have two ties instead of one to hold the joint.

W. E. CLARKE. Seven years ago I laid a piece of track with suspended joints, and plain fish plates, and have had no trouble in its maintenance. I use broken joints. On our heavy grades I put a pair of fish plates at the middle of each rail opposite the joint on the other rail, using two bolts and four spikes. Thus each rail has four ties to hold it from going down hill. (In answer to questions) I don't think this necessary except in extreme cases, but on a piece of track like the one referred to, I think it worth all it costs as a safeguard against accidents.

Mr. SHANKS.—Regarding the risk from drilling the bolt holes through the rail, it seems to me there can be very little. Even if the rail does break at the bolt holes, it has the angle bars each side to hold it, and is in effect only another joint.

Mr. ELLIS.—A while ago, I laid a considerable length of track with square joints and the track opposite to it for the same length with broken joints, thinking I would test the two on the same ground. The weather was much more favorable for making a good track when the square joint was laid than it was when the broken joint was laid. My foreman on that section told me he had had to tamp the square joint twice as often as the broken joint to keep it up; also when the Dudley car ran over the line, it put much more ink on the square joints than it did on the broken. I have since then, whenever laying new track, used broken joints.

Mr. LENTELL.—All the steel we lay on this division of the Boston & Albany is laid with supported and broken joints, with a rail brace opposite the center of each joint.

Mr. F. C. CLARKE.—A considerable amount of track with square joints laid some years ago, on the Housatonic has kept in very good condition, largely because of the careful manner in which it was originally laid. However, I prefer the broken joint. Square joints may do well where plenty of good ballast is used, but with the so called ballast which most of us have to put up with, the broken joint will give the best results.

The question was then brought up how far it was advisable to let the joint run past the center of the opposite rail, in laying track with broken joints, before cutting the rail. One member let it vary but 6 ins. either way, but most were of the opinion that no one could tell, when riding over the track, whether it was laid with joints exactly opposite the center or two or three feet either side.

The question of curving rails was then taken up. Most of the members followed the practice of bending to the proper curve before laying, all rails for curves sharper than 2°. Mr. ELLIS thought every rail should be properly bent before laying on a curve, though on a 1° or 2° curve, the inner rail might be left straight.

Mr. DAGGETT said: I laid the second track of the New York & New England road from Williams to Blackstone, 66 miles, on which the sharpest curve was 4½°. The line was laid with broken joints allowed to run not over 2 ft. each way from the center of the opposite rail, and not a rail was bent before laying. I am not in favor of curving rails except for curves sharper than 3 to 4 or 4½°. I use a heavy angle fishplate and a brace chair opposite the joint which helps to hold the track in line.

Some other members did not bend rails before laying until the curve was sharper than 3°.

The following resolutions were introduced and carried unanimously:

(1). That weight of steel rails should never be less than 72 lbs. per yd., and as much heavier as we can secure.

(2). That the best rail cross-section is 4½ ins. high with a 5-in. base, with a head to fit as nearly as possible the shape of the wheel flange, with no sharp corners and a top flat enough to give at least 1¼ ins. for wheel friction.

(3). That rails should be curved before laying on any curve sharper than 2°.

(4). That they should be curved with some form of machine that will not produce a concussion on the rail.

(5). That the broken joint is preferable, all things considered.

The resolution that a suspended joint is best was adopted by a vote of 12 to 9.

The committee on the best forms for keeping accounts of material used and labor performed (F. C. CLARKE, M. E. COOK and S. C. PAXTON) reported some progress, and asked to be continued another year, promising to make out their report as soon as possible and send printed copies of the forms recommended to each member. The request was granted.

The next question for decision was the maintenance of the roadbed outside the rails. None of the members of

the committee appointed to report on the subject were present, but a written report was presented, which recommended that brush and weeds be mowed each year about the last of August, for a distance of 6 ft. each side of the rails, and that old ties be sold wherever possible.

Most of the members mowed the brush and weeds but once a year.

Mr. W. E. CLARK said that the Vermont law obliging weeds on the right of way to be mown between June 1 and June 15, necessitated the mowing of his line twice each season. He was satisfied that the two mowings cost less than one, as the brush was cut while still tender, and was largely killed out by cutting at this season.

Mr. PATCH also mowed his line twice a year, the first time about June 20, and thus killed the weeds before they went to seed. In this way a large part of the right of way was now well grassed over, and they were not only able to get this cut for nothing by the farmers, but were getting quite an income from selling the right to cut it where there was a fair crop. The brush was piled after mowing and burnt as soon as it was well dried. Old ties were largely burnt at the repair shops, but they were able to sell four or five hundred dollars worth each year.

F. C. CLARKE: Recently I picked up 75 cords of old ties and took them to the shops. I kept an account of what it cost my department, and the Superintendent of Motive Power did the same. It cost us $10 more to get those ties where they could be used for fuel and to cut them up, than we could have bought the same amount of wood for. We sell some ties to lime kilns and when we can do that, think we save about half their value.

Mr. LENTELL: We sell from five to six thousand ties a year. About half our old ties we saw into 4 ft. lengths and use them for fuel at the shops. I think they are worth about 3 cts. a piece to us for this purpose. The other half are made into charcoal.

Mr. PERKINS: Ties can sometimes be profitably used to fill in places which give trouble from sliding. They will soon be grown over with bushes and blackberry vines, the roots of which will hold the bank in place.

Most of the members seemed to be of the opinion that there was but little profit in collecting the ties for use as fuel. To burn them seemed the easiest way of getting rid of them. In burning them some time was chosen when there was no danger of the fire spreading. They could be generally burnt while the section men were engaged at other work near them so that the cost of the labor to burn them was inconsiderable.

The following resolution was passed:

That Aug. 1, is the best time to mow grass and weeds, in the absence of State legislation, fixing a different time. That the best way to dispose of old ties is to burn all which cannot be sold at a profit. That the section should be kept as neat in its appearance as economy will permit.

The next subject taken up was Nut Locks.

A MEMBER: I use the Ruffner & Dunn, National, Verona and Fiber. Of the Ruffner & Dunn, double and single, I have 15,000 in use and I think them the only nut lock to use. I recently put on 4,000 of each, of three kinds, the Fiber, the Verona and the Ruffner & Dunn. At the end of a month, of the Fiber 330 had worked loose, of the Verona 120, and of the Ruffner & Dunn but 31.

F. C. CLARKE: There were 10,000 Ruffner & Dunn nut-locks in use on the Housatonic road when I first went there, and 15,000 have been put on since. Until I find something better I shall stand up for the Ruffner & Dunn as the best.

Mr. ELLIS: Here is a Verona nut-lock which has been in service since 1875 and there is still some elasticity in it. The great advantage of the Ruffner & Dunn is that it is not as easily lost as the smaller nut-locks. The Verona nut-lock gives me good satisfaction, but I am still using a large number of the Hoopes & Townsend bolts without nut-locks, and find that they do not give me much trouble from loosening.

Mr. LENTELL: We use the Atwood nut the whole length of this division (Boston & Albany) and they are very satisfactory.

The following resolution was adopted: That it is still the opinion of this Convention that the Ruffner & Dunn or Excelsior nut-lock is the best yet presented.

It was voted to hold the next annual Convention on the third Wednesday in August, 1889, and the Association then adjourned for dinner.

At the afternoon session the only technical subject discussed was road tools.

Mr. ELLIS referred to the Verona spike puller shown the previous year as a tool of much merit. For a track jack he preferred the Jenne and had 26 in use.

Mr. PERKINS: I bought 2 doz. Verona spike pullers last year and think them the handiest little tool that I ever used. I have the Jenne jack and they are tools which pay for themselves very quickly. For an automatic drill I use the one made by Pettibone, Mulliken & Co.

Pres. LANE: I think a good clawbar will save as much money to a railroad company as any track tool. A good clawbar will occasionally break. They should be long and thin at the point to do rapid work; not short and blunt, as blacksmiths are inclined to make them. I regard this discussion of our tools as an important part of the proceedings of this Convention. The Sheffield hand-car I first saw at one of our conventions and ordered one on trial. After it had been in use a few weeks I asked the foreman how he liked it. He said if it had got to be returned, himself and men would pay for it rather than lose it. The Ruffner & Dunn nut-lock was brought to our notice in a similar way. I ordered one of the Smith rail saws last year and we have used it considerably at one place in fitting up the turntable tracks at a round house. If in a hurry, very fair results can be obtained in much less time by sawing through the ball of the rail and then breaking it with a sledge. I am going to try some Servis tie plates. As we have to take out our ties within 4 or 5 years on account of the cutting in of the rail, I am anxious to find something that will avoid this and lengthen the life of our ties. I think these plates will also help to hold the track to gauge.

Mr. BISHOP: We have some Servis tie plates, some of which have been in use two years. Some of these have begun to turn up at the end. They hold the rail firmly. There is one nuisance about them; it is hard to shim over them in the winter. I think they will perhaps permit the use of ties of softer wood than we could otherwise make into ties, cedar, for instance.

Mr. BISHOP also related three accidents which had recently occurred through the derailment of hand cars at point switches. The hand car was on the main line, trailing the switch. The accident was due to the dropping of the wheel on the point which was planed low, crowding the opposite flange over the top of the rails.

The following resolution was adopted: That we appreciate the great improvement in road tools which has tended toward economy in the work of the track department. Work done on track with poor tools is at the expense of muscle and economy; and we further resolve to introduce, as far as we can, the improvements which we are convinced by our own experience or the testimony of others, are valuable improvements.

Resolutions of thanks and votes empowering the Association's officers to go on with the work for the ensuing year, were passed, and after a closing prayer by Chaplain NEWCOMB, the Convention was adjourned. On the following day several of the members and their friends accepted the courtesy of General Manager FURBER, of the Boston & Maine, and enjoyed a pleasant excursion to Old Orchard Beach.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Buffalo, Rochester & Pittsburg.—The contract for the extension known as the Johnsonburg Railroad, 24 miles in length, has been let to D. L. MILLER and B. E WELLENDORF of Lock Haven, Pa.

Toledo, Saginaw & Mackinac.—Tracklaying on this Michigan road was completed to East Saginaw, 50 miles from Durand, the southern terminus, on Aug. 17. The line was built by Saginaw capitalists; but as announced last week, its early sale to the Toledo, Ann Arbor & North Michigan, or the Grand Trunk is very probable.

Lancaster & Hamden.—A report from Circleville, O., to the Cincinnati *Enquirer* says:

Much dissatisfaction is expressed along the line of the proposed Lancaster & Hamden Road at the inactivity of the contractors. The road bed has been completed for a distance of 20 miles for six months past, and numerous promises have been made for some time past that the work of putting down the iron would be commenced at an early day, but there is no evidence of it, and the people have abandoned all hope of its construction.

Raritan River.—CHAS. VAN HOUGHTON, a contractor on this New Jersey railroad, recently disappeared with $5,000, leaving the laborers who where at work for him in the lurch.

Grand Trunk.—The Beauharnois Junction Railway will probably be open for traffic by Sept. 15. The iron bridge over the Chateaugay river has just been completed.——It is announced that the company on account of the rumors of an alliance of the Canadian Pacific with the Wabash will extend the Michigan Air Line Railway to give them an independent line from Detroit to Chicago.

Whitefield & Jefferson.—A reconnoissance has just been made by a party of capitalists interested in this road and the Concord road, for an extension from Jefferson, N. H., through Randolph, Gorham, Berlin and the upper Androscoggin Valley to Errol and thence to the Canada line. The great timber district which would be opened up by this road, renders its early construction very probable.

New York, Mahoning & Western.—The latest obstacle set in the path of this company is in the collection of the $57,000 subsidy subscribed by citizens of Findlay, O., to be paid when trains were run from Ottawa to Findlay. The subscribers to this fund now claim that the notes were obtained by misrepresentation, and will fight their case in the courts.

South Pennsylvania.—According to the Pittsburg *Chronicle Telegraph*, the hitch in the resumption of construction on this road is due to a dead-lock betwee the Pittsburg and the Philadelphia stock holders. The former have not yet signed the agreement for reorganization, and will not do so until the VANDERBILTS make a better proposition. It is stated that the delay has now extended so far that there is danger of a lapse of the charter, and with the Pennsylvania influence against it, it might be difficult to obtain the right of way under a new charter.

Pennsylvania.—Surveys have been made for a short cut from Butler to Newcastle, Pa., about 25 miles. The line would save a considerable haul on much through traffic, and though it runs through a rough and hilly region, is likely to be built.——A press despatch from Pittsburg quotes one PETER AHL as stating that capitalists from Perry County, Pa., have subscribed $15,000 toward the expenses of surveying a Pennsylvania line to parallel the South Penn. The new line is to begin at Newville, 30 miles west of Harrisburg, on the Cumberland Valley railroad, and run west, striking the Allegheny mountains at Doubling Gap. The line runs up the gap six miles, then crosses the range with five tunnels, coming out on Connequigig creek and thence continuing west 150 miles over an unstated route. It is stated that President ROBERTS and a corps of engineers are to go over the line at once and determine on its feasibility. ——The transfer of the Cincinnati, Richmond & Chicago railroad from the Cincinnati, Hamilton & Dayton, to the Pennsylvania company has finally been effected.

Cincinnati, Sandusky & Cleveland.—This company has awarded the contract for 200 box cars to the Terre Haute Car Works.

New Projects and Surveys.

Springfield & Connecticut.—This company has been organized to build a railroad from Springfield, Mass., to the Connecticut State line in the town of Agawam, about 7 miles. The incorporation is in the interest of the Hartford & Connecticut Western Company, who wish to extend their line to Springfield at an early date. Application is to be made at once to the Railroad Commissioners for a certificate of exigency for the construction of the road.

Allentown Terminal.—A charter has been granted to this Pennsylvania company to build a railroad, 3 miles in length, in Hanover township. The line is in the interest of the Philadelphia & Reading Co.

Massachusetts.—A meeting was held at North Attleboro, Mass., on Aug. 16, to discuss the project for a railroad to run from the New York & New England Railroad at West Walpole to the same road at Adamsdale, passing through Wrentham, Plainville and North Attleboro. A preliminary survey has been made by private parties and the cost is estimated at $400,000. At the meeting $30,000 was subscribed to the capital stock and enough more is to be secured to warrant the filing of articles of incorporation and the securing of right of way. It is expected that the New York & New England will lease and operate the road.

SOUTHERN

Existing Roads.

Louisville Southern.—Estill county, Ky., has voted a subscription of $100,000 to this company in aid of the extension known as the Richmond, Nicholasville, Irvine & Beattyville road. This makes $550,000 subscribed in aid of the extension of the road to the Three Forks.

Kansas City, Memphis & Birmingham.—Grading is to begin at once on the extension from Aberdeen to Columbus, Miss. It is intended to complete the line this season if possible.

Covington & Macon.—There is a hitch in the work on this Georgia road, owing to the failure of the city of Athens to comply with her agreement in reference to granting the right of way. General Manager E. C. MACHEN has been ordered to survey a line from Watkinsville to Elberton and Atlanta, to be built in case the Athens people fail to grant the desired entrance to that city. It is probable that the difficulty is only temporary, and that arrangements will soon be made for completing the line to Athens.

Tennessee Central and Alabama.—A letter from Trenton, Tenn., to the Nashville *American* says:

Work on the Tennessee Central & Alabama Railroad is progressing so slowly that it has been suggested that the best use that can be made of the roadbed between here and Milan is to sow it to turnips this summer. A wise and timely suggestion, the people of Trenton think. If ever a community was "monkeyed" with in regard to having a railroad built, we think this one has been. Trenton has twice voted the bonds asked for to build this road, and still about the only thing that is being done now, is two or three persons are at work cutting down weeds on the roadbed with scythe blades and weeding hoes.

Virginia & Carolina.—This company's partly graded roadbed and its franchises, rights of way, etc., were sold on Aug. 16, at Richmond, Va., to MONCURE D. ROBINSON and others, —that is to the Seaboard Air Line Company. The line was projected to parallel the Richmond & Petersburg and the Petersburg & Weldon roads.

Albemarle & Raleigh.—It is reported that this road, which runs from Williamstown to Tarboro, N. C., and is a part of the Atlantic Coast Line system, has been purchased by the Richmond & Danville, and will be extended to Raleigh as originally projected.

Louisville & Nashville.—J. W. Worthington & Co. of Birmingham, Ala., have been awarded the contract for

another division of the Birmingham Mineral extension to Huntsville, Ala., 19 miles in length.

Central Railroad of Georgia.—Tracklaying has just been completed on the extension from Clayton to Ozark, Ala.

Norfolk & Western.—A rumor of rather doubtful authenticity is in circulation that the company intends to double track its line from Roanoke to Lynchburg, Va.

Tennessee & Coosa.—Work on the extension of the Tennessee & Coosa R. R. in Alabama has been suspended, owing to some difficulty in negotiating the bonds. Eleven miles of the road are completed and in operation, and work was progressing on the balance of 65 miles, all of which has been carefully located and the right of way secured. Plans were in preparation for a bridge across the Tennessee river at Guntersville. Mr. William H. Case, Chief Engineer and General Manager, resigned his position on the failure of the company to properly equip the road and push the work. It is expected that arrangements will soon be made to continue and complete this important road.

New Projects and Surveys.

Memphis & Knoxville.—A project is being agitated at Bolivar, Tenn., for reviving this defunct project. The graded roadbed extends from Bolivar to Henderson, Tenn., about 30 miles, and franchises had been secured for a line through Wayne and Lawrence counties and on east to the Cumberland mountains. It is now proposed to put the old roadbed in condition for use, lay the rails and extend the road east *via* Henderson, Lawrenceburg, Waynesboro and Pulaski. The road would develop a section of southern Tennessee rich in mineral wealth, and now distant from railroad facilities, and seems to have much in its favor.

Perry & Eastern.—HAZLEHURST & HENDRICK, of Macon, Ga. have just completed surveys from Perry, Ga., to Kathleen, on the Georgia Southern & Florida railroad.

Hodgdenville & Glasgow.—J. P. THOMPSON, C. E., of Harrodsburgh, Ky., LAWRENCE KING, of New York City, and Hon. H. D. SMITH, of Hodgdenville, Ky., have made a reconnoissance for a railway line from Hodgdenville, Larue county, Ky., to Glasgow, Barren county. They stated that they represented an "Eastern syndicate" and that the line would be built at once. The local aid is to be raised by private subscription.

———The following item we clip from a contemporary not exactly because of its financial, technical or commercial importance, but in the hope that the writer will be moved to inform an anxious world whether he "proposes" to hitch on his toboggan behind his railroad in actual practice:

WILMINGTON, N. C., August 13, 1888.

Editor Manufacturers' Record:

I intend running a railroad on the beach near Wilmington, N. C., and also a toboggan. S. VAN AMRINGE.

THE NORTHWEST.

Existing Roads.

Northern Pacific.—Very conflicting reports are sent from Winnipeg relative to the deal between this company and the Manitoba Government. According to some, the entire scheme has fallen through and will not be taken up again. Others deny this, and say with certain amendments, which are now under discussion, the contract is certain to be ratified by the provincial legislature. It seems altogether likely that with the certainty that a contract can be made greatly to the advantage of both parties, an arrangement of some sort will be perfected and carried out. The Manitoba Government has already let contracts for the Portage extension, and grading has begun.——A report is gaining some credence that the Northern Pacific is to have its eastern terminus at Chicago at an early date, running over the Wisconsin Central.——A survey which is being made from Mandan, Dak., to the Black Hills is said to be in this interest.

Winnipeg & Hudson Bay.—A dispatch from Winnipeg reports that ANDREW ONDERDONK and other capitalists have renewed their offer to complete this line, providing the Government's act is put in force, guaranteeing $4,500,000 of 4 per cent. bonds for 25 years.——The 40 miles of track laid last year from Winnipeg to Lake Manitoba is said by the Manitoba *Sun* to be "covered with grass to such a height that the services of a mowing machine would be required in order to see the rails.

St. Paul, Minneapolis & Manitoba.—The city of Yankton, Dak, has subscribed $100,000 in aid of the extension of the Manitoba road to that city.

Chicago, Burlington & Quincy.—The surveys have been made for an extension to Lead City, Lawrence Co., Dak., the line crossing the Fremont, Elkhorn & Missouri Valley road at Whitewood.

Winona & Southwestern.—The contract for bridging and piling has been let to Matthews & Van Norman, of Minneapolis.

Illinois Central.—The following item is being given a wide circulation in the daily press, and we reprint it for what it is worth. We are far from believing, however, in its accuracy or authenticity.

Recent movements in the railroad field tend to confirm the belief that the Illinois Central will not only invade Nebraska, but also Wyoming and possibly Colorado. The objective point is either Ogden or Denver, with the odds in favor of the former. Articles of incorporation of the Wyoming & Eastern Railroad Company have been filed with the Secretary of the Territory at Cheyenne. This is believed in well-informed quarters to be the local name of the Illinois Central. The capital stock is $10,000,000, and the length of the road to be built in the Territory is 425 miles.

"The initial point of the road is at or near Twin creek, on the southwestern boundary of Utah and Wyoming, where it will connect with another road to Ogden and Salt Lake City. The route designated is easterly and northeasterly, through the valley of Horn Fork, in Uintah county, the South Pass, the Sweetwater and North Platte valleys to the Nebraska boundary in Sioux county. Several branches are also proposed, one southward from Independence Rock through Carbon county, and one through the Sweetwater valley to the northern boundary of the Territory. The company is already at work on the road at the western end, and surveyors are moving eastward, selecting and staking the route.

The undertaking is a huge one, but the men at the head of it have ample means and will push the road as rapidly as possible. Seven hundred men are now at work on the road. The route through Nebraska can be readily seen by a glance at the map. Between the main lines of the Elkhorn Valley and Union Pacific road is a vast unoccupied stretch of country, an empire in itself, the productive wealth of which has scarcely been touched. Here lie the counties of Sioux, Box Butte, Grant, Blaine, Thomas, Loup, Garfield, Wheeler, Madison, Stanton, Cuming and Burt, presenting an unexcelled field for railway enterprise. The eastern counties are well settled and support hundreds of thriving communities, while the central and western counties are in the infancy of development. They have been retarded by lack of facilities for reaching markets; but the growing and gathered crops, the herds of live stock and the increase of population which will naturally follow, insure profitable returns to the first railroad in the field. Crossing the river at Onawa, the route indicated to the mountains would be an air line, and would lead rival lines a lively race for overland traffic.

Wisconsin Central.—The extension from Marshfield to Chippewa Falls will be completed next year. Five miles of the line have been cleared, and 10 miles more are to be cleared and graded this season. The new line will be about 30 miles in length and will be a link in a direct route from Chicago to St. Paul, shortening the present route of the Wisconsin Central between those points about 25 miles.

New Projects and Surveys.

Duluth, Red Wing & Southern.—The contract for the construction of this Minnesota road has been let to the Red Wing, Duluth & Sioux City Construction Co., and a sub-contract for 90 miles has been let to Keating Bros. & Co., of Pittsburg, Pa. Sub-contracts have been let to ANDREW DANIELSON and H. E. PERKINS, of Red Wing, and D. L. BILLINGSLEY, of St. Paul.

Mt. Olive Coal Co.—This company has been incorporated in Illinois to build a railroad from Mt. Olive to Litchfield by A. C. GRUBB, A. H. JEFFRIES, A. T. ALVEY, A. M. WING and J. W. MCDANIELS, all of Springfield, Ill.

St. Paul New Ulm & Southwestern.—A party has finished a preliminary survey of this road from St. Paul to Windom and are now going over over the line the second time.

THE SOUTHWEST.

Existing Roads.

Cleveland, St. Louis & Kansas City.—This Missouri company has filed a mortgage to the Holland Trust Company, of New York City, to secure bonds to the amount of $4,000,000 bearing 5 per cent. interest. Surveys are in progress for the division extending from St. Charles, Mo., to a point on the Mississippi river opposite Alton, Ill.

Missouri Pacific.—It is announced that the contract has been let to McCarthy & Kerrigan, of Little Rock, Ark., for constructing 16 miles from Fort Smith to Greenwood, Ark., on the Fort Smith & Gurdon Railroad.

Fort Smith, Paris & Dardenelle.—It is reported that ground was broken Aug. 13 on this Arkansas road.

Ft. Worth & Rio Grande.—President PADDOCK is raising local aid along the proposed extension from Granbury, Tex., southwest; and it is hoped that construction on the line can begin by Sept. 4. Chief Engineer KING is now at work on the final surveys.

Atchison, Topeka & Santa Fé.—An extension is rumored to be under consideration of the Gulf, Colorado & Santa Fé line which now has its western terminus at Coleman, Tex. It is proposed to extend it to Sweetwater, on the Texas & Pacific.——The company is said to contemplate double tracking the division from Kansas City to Emporia.

San Antonio & Aransas Pass.—It is announced that the contract has been closed for building the extension to Waco, Tex., by June 1, 1889.

St. Louis & San Francisco.—It is stated that this company has secured the franchise of the Kansas City, Ft. Smith & Southern railroad, and that the surveys which have been in progress along its route for some time, will result in its being adopted for the long delayed Kansas City extension.

New Projects and Surveys.

Kansas City, El Paso & Mexican.—This company was formally organized at Las Cruces, N. M., on Aug. 20, with the following officers: President, H. L. NEWMAN, El Paso, Tex.; Vice-President, ZENO B. CLARDY, El Paso, Tex.; Secretary, MORRIS R. LOCKE, Jerseyville, Ill., Chief Engineer, WM. C. MASTEN. Morris R. Locke & Co. have the contract for building the road from El Paso to White Oaks, N. M., and will begin work at once.

St. Louis, Baxter Springs & Oklahoma—ED. BURGESS, of Lebanon, Mo., is making a reconnoissance over the surveyed line of this road from Joplin, Mo., to Coffeyville, Kan. Further surveys are to be made soon.

Lawrence, Atchison & Southern.—This company has bought the franchise, right of way, and partly graded roadbed of the Lawrence & Emporia, and Lawrence & Carbondale companies. The contract has been let, it is stated, for the line from Atchison to Lawrence, and work is to begin soon.

Augusta & Southeastern.—Organized in Arkansas to build a railroad from Howell, on the Batesville & Brinkley railroad, to Augusta, about 16 miles, by J. L. HOWELL, M. D. THOMPSON, W. A. REED and others. The line will be operated by the Batesville & Brinkley company.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Chicago, Rock Island & Pacific.

HUGO, Col., Aug. 12, 1888.

EDITOR ENGINEERING NEWS:—

The Chicago, Kansas & Nebraska extension in Colorado is now at the Republican river crossing, and track is being laid at the rate of 2¼ miles daily, complete except surfacing, Bethune & Craney Bros. are building all bridges from end of track. Grading to Colorado Springs is practically completed. X.

Vancouver, Klickitat & Yakima.—Work has been suspended on this Washington Territory road until the negotiations for capital to construct the line are closed.

Oakland, Alameda & Laundry Farm.—This short suburban road at Oakland, Cal., has been completed and opened for business. J. H. WOODWARD, the San Francisco representative of the Wabash, is President, and W. B. KING is General Manager.

Guadaloupe Mining Co.—This line from Villadama, on the Mexican National, to the Nunes Viegos mines has just been completed. It is about 20 miles in length.

Denver, Texas & Ft. Worth.—A reconnoissance has just been made of the route for the proposed branch from Trinidad, Col., to Las Vegas, N. M. It is stated that a proposition will soon be made to Las Vegas regarding the early construction of the extension.

Southern Pacific.—The list of incorporators of the Seattle & Southern Railroad Company in Washington Territory includes W. E. BROWN, G. W. PRESCOTT and THOS. EWING of San Francisco, J. P. HOYT and A. B. STEWART of Seattle. Many are confident that the Southern Pacific is at the back of the enterprise.——Tracklaying is completed on the Stockton & Tulare road from Fresno to Poso, Cal., a distance of 102 miles.

Seattle, Lake Shore & Eastern.—A contract has been awarded to the Moose Bay Iron & Steel works for 30,000 tons of steel rails to be delivered next July.

Northern Pacific.—Work continues to be actively pushed on the lines in the Coeur d' Alene mining regions. It is expected that the line will be completed to Mullan this year and next year will be pushed through to Missoula, Montana. The project to widen the gauge of the Coeur d' Alene Ry. & Navigation Co.'s railroad, which the Northern Pacific purchased, has been abandoned; and a new line will be built instead to Wardner and perhaps to Wallace. Grading is to begin at once on the Central Washington line, which will start at Cheney, 16 miles west of Spokane Falls, and run to Ellensburgh, on the Cascade division, shortening the transcontinental line 90 miles. This line will open up what is known as the Big Bend district.

Mexican National.—Grading is now finished on this road and the contractors are returning to the United States. Only about 40 miles of track remain to be laid.

Denver & Rio Grande Western.—The Denver *Republican* quotes President W. J. PALMER as saying that this road will be widened to standard gauge as soon as a standard gauge line is built to connect with it at its eastern terminus.

New Projects and Surveys.

Durango.—

EDITOR ENGINEERING NEWS:—

The Durango Railway is projected to run from Durango to Rico, a distance of 95 miles. Capital for construction is partially secured. The project is in the interest of the Porter Coal Co., the San Juan Silver Mining Co., and the mining and other interests at Rico, Durango and along the line of the road. Contracts will be let within a year for 34½ miles to the Porter Coal Co's. coal mines. CHAS. KREMLEE is Chief Engineer and E. LAUNHART, Jr., is Sec'y.

J. A. PORTER, *President.*

Astoria & South Coast.—This company has been incorporated at Astoria, Ore., and about half the capital stock has been subscribed. The line is projected to run from Astoria to the head of tide water in Tillamook bay, and to Fort Stevens. The incorporation are M. J. KINNEY, W. W. PARKER, E. A. NOYES and M. C. CROSBY.

Stockton, Fresno & Southern.—This company has been incorporated in California to build a railway from Stockton to Visalia, about 200 miles. The incorporators are H. B. HUNT, THOS. R. HAYES, L. M. HICKMAN and others of Stockton. Preliminary surveys have been in progress for some months.

San Luis Valley.—Incorporated in Colorado to build a railroad from Villa Grove, Saguache county, to Monte Vista and La Jara. G. PIERREPONT DAVIS, Hartford, Ct., JOHN P. BRINK, of Denver, Col., and others are interested.

Mt. Hood.—A second company has been organized to build a railroad from Portland, Ore., to Mt. Hood. GEO.

WOODWARD, E. J. JEFFERY, J. W. KERN and others are the incorporators.

Pueblo, Gunnison & Pacific.—Subscriptions are being solicited to the stock of the company, and it is hoped to start the surveys by Sept. 1. The headquarters of the company are at Pueblo, Col. H. R. HOLBROOK is Chief Engineer.

Victoria & New Westminster.—Citizens of Victoria, B. C., have formed a company and propose to build a railway to New Westminster, to connect with the American systems which are to be extended to that point. The route will be from Victoria to Shoal Harbor, 18 miles, thence by a ferry to the mouth of the Frazer river, 25 miles, and thence to New Westminster, about 12 miles.

Proposals Open.

Wells.—One or more tubular or other wells, for additional water supply. J. H. HARLOW, Treasurer, Mattoon Clear Water Co., 411 Wood St., Pittsburg, Pa.

Dredging, Pier, Etc.—Deepening harbor and entrance at foot of Canandaigua lake; building pier and breakwater to protect the same. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. August 27.

Culverts.—Stone culverts at Tonawanda and North Tonawanda. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. August 27.

Sewer and Street Work.—S. C. SLAYMAKER, City Engineer, Lancaster, Pa. August 27.

Street Work.—JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. August 27.

Sewage Well and Pumping Plant.—THE CITY ENGINEER, Sioux City, Ia. August 28.

Sewers.—JAMES BROWN, Comptroller, Allegheny, Pa August 28.

Sewer.—Brick sewer, 1,700 ft. EMERSON GAYLORD Chairman of the Selectmen, Chicopee, Mass. August 28.

Dredging.—In Albany basin; 140,000 cu. yds. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. August 29.

Street Work.—A. E. SMYRK, City Commissioner, Baltimore, Md. August 31.

Quarrying.—Extraction and delivery at Montreal of 20,000 ft. of ashlar and dimension stone from quarry at Phillipsburg. H. LAMONTAGNE,, Secretary, Canadian Quarry Co., 480 St. Paul St., Montreal, Canada. August 31.

Bridge.—Masonry piers and abutments; iron superstructure. Bridge across the St. Francis river at Sherbrooke. Plans and specifications at the office of the engineer in that city. THE QUEBEC CENTRAL RAILWAY CO., Sherbrooke. Que., Canada. August 31.

Building.—Mason and carpenter work, plumbing and steam fitting, for addition to Normal School at New Paltz, N. Y. Architects, FULLER & WHEELER, 86 State St., Albany. SOLOMON DEYO, New Paltz, N. Y. September 1.

Reservoir.—About 40 ft. by 35 ft. by 15 ft. deep. THE PINEVILLE WATER-WORKS CO., Pineville, Ky. September 1.

Bridges.—Three iron bridges. J. T. THOMAS, Grenada, Miss. September 3.

Bridge.—Howe truss bridge 130 ft. long, in one span, across the Chariton river. JOHN H. LEE, County Clerk, Keytesville, Mo. September 3.

Pumping Machinery.—Two vertical compound engines, with boilers, and engine house, to be erected near Ridgewood engine house. Capacity of each engine to be 10,000,000 galls. in 24 hours, delivered into reservoir through a 24-in. force main about 4,000 ft. long. Static head about 167 ft. Separate prices for engines and boilers and for engine house. Drawing, must be presented showing design of engine, boilers and engine house. State time required to complete the work. General specifications and other information may be obtained from the Chief Engineer of the Department of City Works. JOHN P. ADAMS, Commissioner of City Works, Municipal Building, Brooklyn, N. Y. September 4.

Pumping Machinery.—A horizontal, compound, condensing, pumping engine of 12,000,000 U. S. galls. daily capacity, and four steam boilers 5 ft. 6 ins. by 18 ft., tubular type. JAMES BOYD, Village Clerk, Hyde Park, Ill. September 4.

Bridge.—Superstructure of a wrought-iron bridge over the Connecticut river, between Holyoke and South Hadley, Mass. The bridge will consist of 10 spans of about 160 ft. each, with a total width, inside of hand rails, of 46 ft., and with trusses spaced 32 ft. apart on centers. Bids will be received upon either or both of two alternative designs, one having "Pin Connected" trusses, the other having "Riveted Lattice" trusses, in accordance with plans and specifications which will be furnished by the Commissioners, and which may be seen at the office of the City Engineer, Holyoke, Mass. LEONARD CLARK, Chairman, Joint Board of County Commissioners, Springfield, Mass. September 5.

Artesian Wells.—Well 5 ins. diameter inside of casing. Price per ft. without guaranteeing asupply, or gross sum for well with supply guaranteed. D. L. HEIMSHEIMER, Chairman of Water-Works Committee, Glenwood, Ia. September 6.

Electric Lighting.—Arc lights on poles or mast arms; incandescent lights in public buildings. JAMES BROWN, Comptroller, Allegheny, Pa. September 6.

Pump, Boiler, Pipe, Etc.—For water supply system at Fort Spokane, Wash. Ty. J. G. C. LEE, U. S. A., Chief Quartermaster, Dept. of the Columbia, Vancouver Barracks, Wash. Ty. September 7.

Paving.—BRYAN CALLAGHAN, Mayor, San Antonio, Tex. September 8.

Bridge.—Over Chapman's creek, near Tremont. Steel or iron bridge, 73 ft. extreme length, 14 ft. roadway, 100 lbs. capacity per sq. ft. O. F. SERVISS, County Auditor, Springfield, O. September 17.

Canal Work.—The construction of two locks and the deepening and enlargement of the upper entrance of the Galops canal. And for the deepening and enlargement of the summit level of the Cornwall canal. The construction of a new lock at each of the three interior lock stations on the Cornwall canal between the towns of Cornwall and Maple Grove; the deepening and widening the channel way of the canal; construction of bridges, etc. A. P. BRADLEY, Secretary, Dept. of Railways & Canals, Ottawa, Canada. September 25.

Canal Work.—The construction of a canal and locks on the Canadian side of the river, through the island of St. Mary, Sault Ste. Marie, Ont., Canada; separate bids for this work and for deepening and widening the channel way at both ends of the canal and construction of piers, etc. A. P. BRADLEY, Secretary, Dept. of Railways & Canals, Ottawa, Canada. October 23.

Contracting.

Pipe.—The Glamorgan Works, at Lynchburg, Va., has been awarded the contract for pipe for the water-works improvements at Lexington, Va.

Creosoting Works.—The new creosoting works at San Pedro, Cal., are completed and ready for operation. The Chief Engineer of the Harbor Commissioners has been directed to prepare plans and specifications for creosoting works, and will examine the works at San Diego and Bellona.

Steam Heating.—At Holyoke, Mass., the contract for two 20 H. P. boilers has been awarded to Scannell & Whaley, of Lowell, at $570. The contract for piping was awarded to J. H. Carpenter, of Holyoke, at $1,410,

Buildings.—Thomas McGrath, of Newark, N. J., has been awarded the contract for the mason work of the proposed new steel works of Mr. John Illingworth, in Harrison, for $10,200, and James Wade, of Harrison, secured the contract for excavating 4,200 cu. yds. of earth.

Steel Rails.—At Seattle, Wash. Ty., the Seattle, Lake Shore & Eastern R. R Co. has awarded to the Moss Bay Iron & Steel Co. the contract for 30,000 tons of steel rails, their delivery to commence next July. The works of the Moss Bay Co. are now in process of construction on Lake Washington, 5 miles from the city, and will be the largest west of the Mississippi. Their iron supply is in Snoqualmie Pass, about 30 miles from the works.

Electric Railway.—The West End Street Ry. Co., of Boston, Mass., has decided to operate its lines by electricity. A contract has been made with the Sprague Electric Co. for plant for the Brookline section, where poles and overhead wires will be used. A contract has also been made for the Bentley-Knight system of underground conduits in Boston, where poles and wires are forbidden.

Town Hall.—The following were the proposals for the construction of the new town hall at Loveland, O.: Frank Whitely, Springfield, $12,358; A. B. Brock, $13,035; J. F. Hanold, Batavia, $13,175.22; Hurst, Recker & Co., Cincinnati, $13,575; W. H. Merrill, $13,725; P. W. Skillman, $13,940; Diss Bros., Delhi, $14,327. The contract was awarded to Frank Whitely.

Sewerage.—***Lawrence, Kan.***—The city has just adopted a system of street grades and a sewer system of the "separate" type, and the Council has ordered about 9,500 ft. of pipe laid at once. The plans were made by H. L. MARVIN. A storm water sewer with opening 4 ft. ×5 ft., side walls stone, with stone paving and brick arch was let recently at $4.70 per running foot.

Water-Works.—***Amsterdam, N. Y.***—The following proposals have been received by the Water Commissioners: Pipe laying: Adam Miller, Saratoga, N. Y., 20 24, 28 and 40 cts. per ft. for 4, 6, 8 and 10-in. pipe, $2,899.28; Ben. Van Vranken, Schenectady, N. Y., 23, 25, 27 and 40 cts.; $2,952.64; Eckler & Schuyler, Amsterdam, N. Y., 26, 26¼, 35½ and 48 cts., $3,350.38; A. C. Phillips, Amsterdam, N. Y., 30 cts. for all sizes, $3,390.90; Brown & Doyle, Cohoes, N. Y., 17, 30, 30 and 42 cts., $3,414.18; Charles Walker, Amsterdam, N. Y., 28, 30, 33 and 38 cts., $1,509.86; T. Sullivan & Co., Syracuse, N. Y., 29, 30, 34 and 96 cts., $3,900.84. River crossing: T. Sullivan & Co., Syracuse, N. Y., $3.60, $1,472.40; Adam Miller, Saratoga, N. Y., $3.75, $1,533.75; Eckler & Schuyler, Amsterdam, N. Y., $1,811.87; J. F. Ward, Jersey City, N. J., $7, $2,863. Contracts have been awarded as follows: Pipe laying, Adam Miller, of Saratoga, N. Y.; Mohawk river crossing, T. Sullivan & Co., of Syracuse, N. Y.; valves and hydrants, Ludlow Valve Mfg. Co., of Troy, N. Y.; cast-iron pipe and special castings, Chas. Millar & Sons, of Utica, N. Y., at $25.75 per net ton, F. O. B. at Amsterdam. A. H. DEGRAFF is Superintendent and Engineer.

Jail.—The contract for remodeling the old jail at Jackson, Madison Co., Tenn., has been awarded to the Pauly Jail Building Co., of St. Louis, Mo., at $6,500. The other bidders were Van Dorn Iron Work, Cleveland, O.; McDonald Bros., Louisville, Ky.; Champion Iron Fence Co., Kenton, O.

Street Railways.—***New York City.***—Public notice is given that the Commissioners of Public Parks will receive and consider proposals for the construction and operation of a railway or railways in and through the Central Park Tranverse Roads, in accordance with the provisions of a recent act, at a meeting to be held at their office, Nos. 49 and 51 Chambers St., on Wednesday, Sept. 5.

Canal Work.—JAS. SHANAHAN, Superintendent of Public Works, Albany, N. Y., has awarded the contract for building 1,020 lin. ft. of slope wall on the Chemung canal at Corning, N. Y., to McGreevy & Munroe, of Elmira, at $8.10 per lin. ft. The other bidders were Charles E. and Edwin A. Walker, of Corning, $10.47, and John Lynch, of Horseheads, at $8.50 per lin. ft.

Bridge Masonry.—The Commissioners of Hampshire and Hampden counties, Massachuset s, have awarded the contract for the stone work of the new bridge at Holyoke, to Wright & Lyons. The contract price is about $23,000.

Sewers.—***Pittsburg, Pa.***—The contract for the 33rd St., or Two Mile Run sewer, has been awarded to Evan Jones, of Pittsburg, at the following prices: brick and stone sewer, 5,220 ft. of 8 ft., $19.50 per lin. ft.; 2,084 ft. of 7 ft., $22.50; 2,909 ft. of 6 ft., $17.50; 1,472 ft. of 5 ft., $10.50; 393 ft. of 4 ft., $9.50; 490 ft. of 3 ft., $5.75; 1,470 ft. of 2½ ft., $5; 24 catch basins, complete, $150 each; 21 manholes, complete, $125 each.

Cranston, R. I.—The following proposals for sewer have been received by J. A. LATHAM, C. E., of Providence, R. I.: F. A. Snow, Providence, $3.50 per ft.; Shaw & Whittlesey, Providence, $5.70; R. A. Woodbury & Co., Pawtucket, $8; Thomas Newman, Providence, $515 for work complete.

Canal Work.—The Canadian Minister of Canals and Railways has awarded to Delormier & Bro., proprietors of the Caughnawaga quarries, the contract for stone and the construction of the new retaining wall in connection with the Lachine canal, at Cote St. Paul. Construction cannot be commenced until next spring when the water is out of the canal, and the work must be finished in three weeks after commencement, in order that navigation may not be delayed.

City of Mexico Improvements.—The municipal council has contracted for Nicholson pavements to be laid in sixty streets of the city. While we very much doubt the wisdom of expensive pavements in Mexico before the draining of the city and valley, as experiments have proved that no pavement can be expected to last as long as in other countries while the ground remains saturated with water, we are glad to chronicle this evidence of the council's zeal in behalf of the city. Sixty well paved streets will be a great improvement in Mexico.—*Two Republics.*

Earthwork.—The following proposals for the excavation of about 60,000 cu. yds. of earth, for the improvement of shallow flowage, Pegan meadows, Lake Cochituate, were opened by the Water Board, Boston, Mass., Aug. 15.: Auguste Saucier, of South Framingham, Mass., 28½ cts. per cu. yd.; Thos. F. Maney & Co., of Boston, 29 cts.; James Killian, of Boston, 31⅞ cts.; N. J. Dean & Co., of Boston, 34 cts.; David Hall, of Littleton, Mass., 34½ cts.; Chas. McDermott, of Falmouth, Mass., 35 cts.; Christopher McBride, of Boston, 37 cts.; Wm. Cochlan, of Boston, 44 cts.; S. H. Munson, of Boston, 53 cts.; McCarthy Bros., of Franklin, Mass., 55 cts. The contract was awarded to Auguste Saucier.

Buildings.—The contract for the stone foundations of the new building for the Westinghouse Air Brake works at Wilmerding station, on the Pennsylvania R. R., has been awarded to Reese, Lindsay & Co., of Pittsburg, at $150,000. The buildings will cover about eight acres of ground and include a machine shop 500x250 ft., foundry 500x300 ft., boiler house 150x80 ft, and a blacksmith shop 250x150 ft. The circumference of the property is over a mile in extent. There are over 10,000 perches of stonework in the foundations. The contractors have commenced work and expect to have the foundations completed this Fall ready for the brick-work next Spring. The buildings will be of brick, two and three stories in height.

Depot.—The Baltimore & Ohio R. R. Co. has given the contract for building the new depot in Pittsburg to Philip Walsh & Sons, of Baltimore, Md. The foundation is completed, and the superstructure is to be finished by December 1, the whole costing $90,000. The building will be a handsome one, in the Romanesque style, and the bricks, as per contract, will be Baltimore faced bricks, made by Russell, Burns & Co. The structure will be four stories high, covered with an ornate slate roof, and 100 ft. square. The interior, which is to be in all hard wood finish, will have tile flooring, and the restaurant and every appointment is to be of the finest and most modern sort. The wood work will all be made in Baltimore. The architect is FRANK FURNESS, of Philadelphia, and the resident architect is W. H. BEEHLER, of Baltimore.

Railway.—The contract for the Johnsonbury Railway, in Pennsylvania, 24 miles long, has been awarded to D. L. Miller and B. E. Wellendorf, of Lock Haven, Pa.

Gas and Electric Lighting.—The following proposals have been received by J. K. ROMINE, Chair'n of the Lighting Committee, Orange, N. J.: Excelsior Electric Co., New York, $110 for not less than 120 lights of 2,000 candle power, or not less than 135 lights of 1,200 candle power. Tucker Electric Mfg. Co., New York; $98 for 1,400 c. p., $110 for 2,000 c. p. Edison Illuminating Co., West Orange, N. J.; 40 arc lights of 1,400 c. p., $110 each; 450 Edison incandescent lights of 20 c. p., $20 each. Stuart Lindsley, Orange, N. J., not less than 135 lights of 1,400 c. p., $95 each per year Citizens' Gas Light Co., Newark, N. J.; 200 more hours gas service for each lamp, Bray gas lamp, without charge; 5 miles of pipe to be laid, 3 before Dec. 1, 1889, 1 in second year and 1 in third year of contract; 7 new electric lamps; $22 per year for gas lamps, $100 for electric lights; gas posts, $20. Robert B. Guckley, Orange, N. J.; 45 lights of 60 c. p., for $990 per year and as may be determined; not less than 200 of 20 c. p., $18 per year; 30 c. p., $25; 45 c. p., $35.75; 60 c. p., $47.80. The contract was awarded Aug. 13 to the Excelsior Electric Co., of New York, for 150 lights of 1,400 c. p.; the contract is for 3 years, dating from Dec. 1, 1888.

Bridges.—*Le Sauk, Minn.*—The following proposals have been received by the County Auditor for the iron highway bridge over Watab creek:—Original bids; Minneapolis Bridge Co., Minneapolis, Minn., $1,350 for plate girder, $925 for truss; Milwaukee Bridge & Iron Works, Milwaukee, Wis., $1,400 and $1,050; Wrought Iron Bridge Co., Canton, O., $1,457 and $1,027; King Iron Bridge & Mfg. Co., Cleveland, O., $1,488 and $1,125; Smith Bridge Co., Toledo, O., $1,497 and $1,082.——Modified bids; Minneapolis Bridge Co., $1,113 for plate girder, $989 for lattice girder, $797 for truss; Milwaukee Bridge & Iron Works, $847 for truss; Wrought Iron Bridge Co., $1,175 for lattice girder $873 for truss; King Iron Bridge & Mfg. Co., $1,057 for lattice girder, $917 for truss; Smith Bridge Co., $1,175 for plate girder, $1,117 for lattice girder. The contract was awarded to the Minneapolis Bridge Co., at its modified bid of $797 for truss.

Oysterville, Wash. Ty.—The County Auditor has awarded the contract for the bridge across the Willapa river at the Lilly crossing to the Pacific Bridge Co., of San Francisco, Cal., at $4,874.24. This was the only bid received.

Arkwright, R. I.—The following proposals have been received by JOSEPH A. LATHAM, C. E., of Providence, R. I.:—Masonry; Graves & McCusker, $4.90 per cord; P. McMahan, $4.75; B. S. Chace, $5; R. A. Woodbury, Pawtucket, $6.93; Kenneth McKay, South Attleboro, Mass., $7.——Wood work, Thomas Allwood, $2,950.——Iron work; Dean & Westbrook, New York, $3,550; Penn Bridge Co., Beaver Falls, Pa., $3,700; Berlin Bridge Co., East Berlin, Conn., $3,800; King Iron Bridge & Mfg. Co., Cleveland, O., $3,900; Pittsburg Bridge Co., Pittsburg, Pa., $3,950; Smith Bridge Co., Toledo, O., $3,950; Canton Bridge Co., Canton, O., $3,975; R. F. Hawkins, $4,100. The contract for masonry was awarded to Graves & McCusker; and for iron work to Dean & Westbrook.

Pumping Machinery.—*Lebanon, Ky.*—The following are the proposals for pumping machinery for the new water-works; J. D. COOK, of Toledo, O., engineer: National Iron Works, New Brunswick, N. J.; quadruple, vertical, compound, condensing engine; 1,000,000 and 1,500,000 galls. daily capacity, 60,000,000 duty, $11,500 and $13,600 respectively; same capacities but 90,000,000 duty, $13,225 and $15,640. The prices are for the entire plant set up, including connections, also for Nos. 1 and 3 a 100 H. P. Moore sectional boiler, for Nos. 2 and 4 two boilers aggregating 130 H. P. H. R. Worthington, New York; compound, condensing, duplex, horizontal engine; 1,500,000 galls. capacity, 70,000,000 duty, $25,500, including boilers and complete plant. Otto C. Wolf, Philadelphia, Pa.; duplex, compound, condensing engine, 750,000 galls. capacity, $3,500. Scovel & Irwin Construction Co., Nashville, Tenn.; high pressure duplex engine, 750,000 galls capacity, $3,480, including 2 boilers and complete plant. Davidson Steam Pump Co., New York; compound condensing engines, 70,000,000 duty, $7,150 for 750,000 galls. capacity, with 1 boiler; $11,000 for 1,000,000 galls., with 2 boilers; $13,300 for 1,500,000 galls., with 2 boilers; the prices are for complete plant, including foundations. E. P. Allis & Co., Milwaukee, Wis.; Reynolds-Corliss engines; $5,420 for 750,000 galls. capacity and 70,000,000 duty, also for 1,000,000 galls. capacity and 72,000,000 duty; $7,650 for 1,500,000 galls. capacity and 72,000,000 duty. The prices include plant set up; foundations extra. National Iron & Brass Works, Dubuque, Ia.; compound, condensing, duplex engines, 40,000,000 duty; $2,750 for 750,000 galls. capacity, $2,900 and $2,000 for 1,000,000 galls., $3,500 for 1,500,000 galls.; independent condensers, $500 extra on each. The advertisements for proposals called for pumping machinery (both horizontal and vertical) with a capacity to pump 750,000, 1,000,000 and 1,500,000 galls. per 24 hours into the reservoir, the flow-line of which will be 410 ft. above low-water surface of Rolling Fork river, the source of supply.

Water-Works.—*Lebanon, Ky.*—The following were the proposals for water-works plant received by J. D. COOK, C. E., Toledo, O.: Pipe;—Addyston Pipe & Steel Co., Cincinnati, O., $28.50 per ton for 12-in., $28.75 for 10, 8, 6, and 4-in.; 3 cts. per lb. for specials; Dennis Long & Co., Louisville, Ky., $27.25 for all sizes, except $27.50 for 4-in., 3 cts. for specials; Chattanooga Pipe & Foundry Co., Chattanooga, Tenn., $29 for all sizes, 3 cts. for specials; Scovel & Irwin Construction Co., Nashville, Tenn., $28.50 for all sizes, 3 cts. for specials.——Pipe laying: R. B. Caruthers, Newport, Ky., 15 cts. to 28 cts. per ft.; A. B. Cleveland, Unionville, O., 22 to 38 cts.; Denison & Cowell, Muscatine, Ia., 14 to 30 cts.; Greenwald & Co., St. Louis, Mo., 16 to 30 cts.; H. Merigold, Lima, O., 17 to 35 cts.; M. Philbin, Memphis, Tenn., 16 to 27 cts.; Scovel & Irwin Construction Co., Nashville, Tenn., 20 to 35 cts.——Valves and hydrants; W. Payne, Fostoria, O.; Eddy Valve Co., Waterford, N. Y.; Bourbon Brass & Copper Works, Cincinnati, O.; Chapman Valve Co., Boston, Mass.; Ludlow Valve Co., Troy, N. Y.; R. D. Wood & Co., Philadelphia, Pa.; Whittier Machine Co., Boston, Mass.——Reservoir: Scovel & Irwin Construction Co., $6,960 for work complete; Daisy & England, Lebanon, Ky., $9,270 for work complete.——Building and supply well; Goodin & Goodin, Lebanon, Ky., 15 per M. for brick, $650 for supply well complete, $1,000 for brick stack without foundation; Scovel & Irwin Construction Co., $1,891 for supply well and auxiliary supply pipe, $3.25 per lin. ft. for auxiliary supply pipe, $1,581 for building complete, with iron stack. The works will comprise the following plant: Supply well, building and chimney; pumping machinery and boilers; 8 or 10-in. rising main, 9,600 ft. long; storage reservoir, capacity 1,250,000 galls; 12-in. supply main to city, 10,000 ft. long; 1,520 ft. of 12-in. pipe, 600 ft. of 10-in., 2,760 ft. of 8-in., 9,520 ft. of 6-in., and 5,420 ft., of 4-in.; one 10-in. valve, four 8-in., sixteen 6 in., fifteen 4-in.; thirty-five fire hydrants.

Pipe, Etc.—Charles Millar & Son, of Utica, N. Y., have taken the order from the contractors of the Moravia Water-Works Co., for all the material required for the new water works at Groton, Tompkins Co., N. Y., amounting in to over $12,000. The following are the principal items: 4 500 ft. 8-in. pipe; 4,000 ft. 6 in pipe; 13 500 ft. 4-ins pipe; 4,500 ft. 3 in. pipe, with specials for each size of pipe; also 45 hydrants, water gates, extension valve boxes and the necessary pig lead. Messrs. Millar & Son make a specialty of supplying complete outfits for water works and sewer contractors.

WATER.

Artesian Well.—At Jersey City, N. J., a 400-ft. well has been put down at the bottom of the bay, and it is furnishing a good supply of water. The work was done by the Pearson Artesian Well Co. for H. H. ABERNETHY, for the purpose of supplying water for steamers. The well is located at the end of a pier.

Kansas City, Mo.—The Thomson-Houston Electric Co. took a contract Aug. 15 to put a complete electric light plant in at the exposition building, and agreed, under penalty, to have it completed by Aug 29. The plant will cost $20,000, and work will be carried on by day and night.

Drainage in Illinois.—At Manito, Ill., a movement is on foot to enlarge the Hickory Grove drainage district, a short distance north of town, and to run a large dredge boat through the present ditch, and to excavate several other large ones; thus redeeming several thousand acres of the best ground in the county.

The Niagara Meter Co., of New York and Brooklyn, has been incorporated at Albany, N. Y., by DAVID WILLIAMSON, GEO. W. BERRY, CHARLES N. WILLIAMS and JOHN HOLST. Capital stock, $300,000.

The Gilpin County Light, Heat & Power Co. has been incorporated at Central City, Col., by A. RICKARD, JOHN H. KEMP, and B. H. LOCKE. Capital stock, $25,000. The object of the company is to supply light, heat and motive power for manufacturing and domestic purposes, by means of electricity, steam, etc.

The American Filter Co., of Chicago, Ill., reports having completed a filtering plant with two and a half million gallons daily capacity, for purifying the water supply of the city of Elgin, Ill. It also reports the completion of a filter with 5,000,000 galls. daily capacity for the Joliet Steel Works, of Joliet, Ill., and has a contract for a second order for the same firm. It has just closed contracts for furnishing a complete filtering apparatus for the entire water supply of the city of Mount Clemens, Mich.

Land Reclamation in Wisconsin.—The commissioners recently appointed to make assessments of benefits and damages connected with the proposed Windlake canal, through Racine and Waukesha counties, have handed in their report to the circuit court. The scheme is one of the largest of its kind ever planned in the State, and involves the reclaiming of about 15,000 acres of now worthless swamp lands in the two counties. In Racine county alone 8,000 acres can be reclaimed, and the gain, over and above the cost, will be fully $500,000. Much opposition to the improvement is developing among property owners along the line and may cause a stoppage of the work.

Water-Works.—*Maine.*—Winter Harbor. The Winter Harbor Land Co. is having surveys made for the new water-works.

Massachusetts.—Malden. At a recent meeting of the council an order was passed providing for the purchase of 8 acres of land on Waitt's Mount, upon which to erect a stand-pipe to provide the city with an additional supply of water. The land costs $10,000, and this sum is to be taken from the water fund. The city has also to pay the taxes on the land for this year. An order authorizing the Mayor to issue water bonds to the extent of $15,000 for the purpose of erecting a pumping plant at Spot pond was referred to the finance committee. A communication was received from the water commissioners asking that $15,000 be appropriated for the extension of water-works, and was referred to the finance committee.——Northampton. The Water Commissioners have purchased pipe for a connection with the mains at Florence

Connecticut.—Windsor Locks. It is reported that nothing has yet been done in regard to the new water-works.

New York.—Brooklyn. The Corporation Council will take steps to condemn land along the line of the extension of the water-works, in cases where the owners refuse to sell.——Savannah. The reservoir is being lined.

Pennsylvania.—Lancaster. The water has been drawn from the west reservoir for the purpose of making connections with the new main and the stand-pipe.——Reading. The city officials recently made an examination of the proposed supply from the Maiden creek.

Maryland.—Ellicott City. A number of citizens are interested in the formation of a stock company to build a reservoir and establish water-works. Surveys are to be made at once, and work to be commenced as soon as practicable. For particulars address the mayor.

Tennessee.—Dyersburg. A contract has been made for putting in water-works. For particulars address the mayor.

North Carolina.—Southern Pines. A water and gas company has been organized. President, F. E. MCALLISTER, of 22 Dey St., New York; Secretary, H. P. CLARK.

Florida.—Orlando. Analyses have been made of the water from various wells, and the quality is reported to be excellent.

Alabama.—Mobile. According to report the water question has been settled by the signing of the contract between the city and the Bienville Water Supply Co. for 265 plugs at $50 per year, the city having the right to discontinue and re-locate 10 plugs per year for three years, so as to give protection to unprotected portions of the city. The contract has 6 years to run. The city is to pay proportionately for the plugs until all are put in. The city will also get the advantage of fixed rates for families and business purposes, which cannot be exceeded.——Birmingham. Work has been commenced on a tunnel under Red Mountain for the piping of the Elyton Land Co.'s new water-works. The tunnel will be 2,200 ft. in length, and is to be completed in 8 months.

Michigan.—Port Huron. The pumping machinery has been delivered and will soon be in operation. The works have already cost $222,000.——Owosso. The Water-Works Committee is prospecting for a water supply. A well has struck a flow of water at a depth of 70 ft. and another well is being driven about 200 ft. from the first one.——Lake City. The water-works are completed, and the pumping engine has been started.——Ludington. The Water Supply Co. is laying the foundation for the new Holly pumps, which will have a capacity of 3,000,000 galls. a day—four times greater than the present pumps. When the work under way is completed the company will cast about for some method of supplying a better quality of water, either by sinking wells or extending the pipe farther out into Lake Michigan.

Illinois.—Lake View. The new pump at the water-works was tried Wednesday and gives the desired pressure. It is proposed to run a 20-in. inlet pipe 1,000 ft. further into the lake.——Evanston. The celebration of the completion of the enlargement of the water-works has been postponed till Sept. 15.

Wisconsin.—West De Pere. The voters have declined to purchase the water-works plant, which had been offered that city at its actual cost.

Colorado.—Las Animas. The City Council has introduced an ordinance to authorize the issue of bonds for $30,000 for water-works.

Nebraska.—Florence. About 400 men are at work on the pipe laying, and the water company expects to have the works in operation in October.

Oregon.—Portland. It is proposed to pipe a water supply to the city from Bull Run creek.

Washington Territory.—Ellensburg. The water-works are completed.

California.—San Diego. The San Diego & Coronado Water Co. has offered to sell its property to the city, and the City Trustees have directed an election of decide upon the issue of $2,000,000 worth of bonds for the purpose of purchasing the works.

Arizona.—Phœnix. The Council has amended the ordinance granting a franchise for new water-works to J. J. Gardiner & Co., so as to enable them to extend the system over the entire city, and has ordered 40 hydrants for fire purposes.

Newark, N. J.—The city has now nearly 75 miles of sewerage. Contracts were awarded for the construction of 33,445 ft. last year, at a total cost of $85,852, and private parties built over 8,500 ft. at a cost of $14,054. During the last 6 months the construction has not been proportionately as great as last year, aggregating only a little more than 12,000 ft.

Cairo, Ill.—In connection with the artesian well project, the Cairo *Argus* gives the following particulars of a boring made at the river some years ago by the Illinois Central R. R. Co. The findings of this boring were as follows: 3 feet sediment; 12 feet coarse sand; 2 feet coarse gravel; 17 feet coarse sand and gravel; 6 feet quick sand; 4 feet coarse sand; 5 feet quick sand; 7 feet fine and coarse sand; 4½ feet coarse sand and fine gravel; 5 feet coarse gravel; 16 feet coarse gravel and fine sand; 12 feet fine yellow sand; 10 feet coarse yellow sand; 15 feet sharp white sand; 10 feet fine red sand; 12 feet fine sand and gravel; 24 feet red sand and gravel; 5 feet white pipe clay and good pure flowing water; 1½ feet yellow sandstone; 5 feet shaly rock with open seams; 15 feet quick sand.

New York City.—The New York *Times* recently printed the following statement by Mr. G. W. BIRDSALL, Chief Engineer of the old Croton aqueduct; the statement being made in answer to many complaints from householders suffering from the unusual scarcity of water:

"We are now from a story and a half to two stories below what we were 6 weeks ago. We are using about 5,000,000 galls. extra a day from the Central Park reservoir. The worst of it is that there can be no increase in the supply of water until after the completion of the new aqueduct. New York, as far as its water supply is concerned, is 'on the ragged edge.' I have been looking forward to the Fall of 1889 as the time for relief to come, but I now begin to have my doubts. We will remain 'on the ragged edge' until the new aqueduct is built."

Irrigation.—***Kansas.***—The Peoples' Irrigation & Water Supply Co. has been incorporated at Topeka, by E. J. COY, of Kendall; E. H. NEILSON, A. GODLEY, M. B. CRAWFORD, and others. Capital stock, $50,000.

Colorado.—The Fowler & Rocky Ford Ditch Co. has been incorporated at Pueblo. The principal office will be at Rocky Ford. Fourteen miles of the proposed ditch will be built at once, which will water fully 80,000 acres of land. The ditch commences at the mouth of the Huerfano creek in Bent Co. and runs south to Timpas creek. Capital stock, $500,000. The Directors are J. E. GODDING, CHAS. W. FENELSON, H. D. G. NANCREDE, J. M. HENDRICKS and A. C. CONNOR.

Washington Territory.—Work has been begun on the Sunnyside canal near North Yakima. It will reclaim several hundred thousand acres on the east side of the Yakima river. The canal will cost $500,000; and will be built by the Sunnyside Irrigating Co.—Stone, Johnson & Co., of Tacoma, have begun work on an irrigating canal near North Yakima. It will tap the Natchez river at Oak Flat, and run in an easterly direction into the Selah valley.

Hartford, Conn.—The work of cleaning and repairing the gate house at the West Hartford distributing reservoir has been completed. The building has been cemented within and without from the foundation, and is now in condition to make a descent into it safe when necessary. This, it is believed, will enable spongilla to be cleared away as soon as it forms, and so keep the water from contamination. The replacing of old cement pipes on the West Hartford main with cast-iron pipes, which has been going on for some time, has now been suspended. One of the mains is all iron pipe. The other, in which cement pipe has made so much trouble, is now of iron for nearly all its length. From the reservoir to near the brook west of Foote's Corners the cement remains, but from there to Hartford all is now iron, except about 1,800 ft. All the trouble that has come with this piping is believed to be due to poor contract work. Where the work was done by the Board's own employés there have been no breaks. Recently in taking out the cement pipe and putting in iron a spot was found where the inner lining of cement had so crowded together when soft that the diameter had been reduced from 20 ins. to not above 16 ins.

Buffalo, N. Y.—The enlargement of the water supply tunnel has been completed. The work occupied about 7 weeks; including the clearing away of the debris, while the contract allowed 8 weeks. The works will now have a daily capacity of 200,000,000 galls. Of the 12,000 ft. of 36-in. pipe to supply the East Side, about 3,000 ft. have been laid; this work has been delayed by slow delivery of pipe, owing to a recent fire at the Buffalo Cast-Iron Pipe Works. There are also 3 miles of 6-in. pipe to be laid. The Water Commissioners have caused telephone and electric light cables to be laid in the new tunnel to furnish light and easy communication with the inlet pier. A telephone will be placed in the pier-hut, and four 50-candle-power incandescent lights will be placed on this artificial island. Two cables are being laid in the bottom of the tunnel. The telephone cable is double, each rope consisting of 16 copper strands, and each wound with cotton soaked in asphaltum. The twin cables are then encased in a coating of lead, and are thus insulated and rendered impervious to water and able to resist the action of ice, should ice find its way into the tunnel. The electric light cable is wound with stout wire and is stronger and heavier than the telephone cables. It is not anticipated that any trouble will arise from ice in the tunnel next winter or spring. But if ice does clog the inlet, it can be speedily removed by an ice elevator, a precautionary device built especially with this end in view. It will be worked by steam and can scoop out the ice as fast as it can come within reach of it. The Commissioners do not fear any more such trouble as was experienced last winter.

Cheboygan, Mich.—According to report there is complaint that "the artesian wells have about ruined the private wells", presumably by draining them.

Drainage at New Orleans, La.—The draining plant is reported to be in a very dilapidated and inefficient condition, the machines being broken and worn out and the buildings very much out of repair. The *Times-Democrat* says:

"Our draining machines, it will be seen, have become so disabled and feeble that they can do less than half the work expected of them, and required of them. Considering their condition they are doing very well. We can expect nothing better of them; we may, indeed, anticipate a break down some day that will leave us in a chronic condition of overflow. It is quite evident that New Orleans must put up with its present rain floods, or expect something even worse in this line unless the people can agree upon some general plan of draining, and upon some system of taxation by which the money needed for it can be raised. We cannot get exemption from floods without new draining machines, and we cannot get the latter without money. These facts should be impressed upon the minds of the citizens of New Orleans until they arouse themselves fully to the absolute necessity of a more thorough and efficient system of drainage here."

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

PROVIDENCE, R. I., Aug. 20, 1888.

EDITOR ENGINEERING NEWS:—The Wakefield Water Co. is constructing a system of water-works to supply Wakefield, Narragansett Pier and Peace Dale, R. I. J. Herbert Shedd is the engineer for the company. The permanent population to be supplied is 3,000 and the summer population, 6,000. The supply is from water bearing gravel near Saugatuck river, in Peace Dale. Water will be pumped to a stand-pipe 190 ft. above tide level. The area to be supplied is generally from 10 to 60 ft. above tide level, but at extreme points it rises to 130 ft. The estimated cost of the works is $133,000. The contract for pipe-laying has been awarded to F. B. Durfey, Norwich, Conn. Richard Pancoast, New York City, is President of the company. J. HERBERT SHEDD, *Engineer.*

We are indebted to JNO. W. HILL, Cincinnati, O., for descriptions of water-works at Findlay and Franklin, O., and Clarksburg, W. Va., for use in the MANUAL. These works were designed by Mr. HILL, and are being constructed under his supervision. The works at Franklin were completed in July. The system at Clarksburg will be finished Oct. 15, and the one at Findlay Jan. 1889.

We give below a description of the water-works at Louisiana, Mo., which was kindly given us by the American Water-Works & Guarantee Co., Ltd., of Pittsburg, Pa.

LOUISIANA, PIKE CO., MO., is a thriving manufacturing city, on the west bank of the Mississippi river, about 50 miles northerly from St. Louis. It has a population of about 5,500, two large tobacco factories, two flour mills, one foundry, and other manufacturing concerns. Three railroads pass through the town, viz: the Chicago & Alton, the Chicago, Burlington & Quincy, and the St. Louis, Keokuk & North Western.

In the spring and summer of '87, the need of a water-works system was urgently felt, as the town was wholly dependent on its wells and springs for a water supply. Accordingly there was formed in August of that year the Louisiana Water Co. with a capital of $100,000, for the purpose of constructing an adequate water-works system for domestic use and fire protection. A majority of the stock being held by the American Water Works & Guarantee Co., Ltd., of Pittsburgh, Pa., that company entered into contract with the local company to construct the works. A franchise was granted by the City Council Aug. 2, 1887, and work was soon commenced. The entire works, with the exception of a part of the reservoir, were completed, and formally accepted by the City Council, on Feb. 29, '88, after a satisfactory test.

The works consist of 6⅛ miles of cast-iron pipe, ranging in size from 12 to 4 ins. in diameter, a handsome brick pumping station on the bank of the Mississippi river, and an earth reservoir with a capacity of 1,200,000 galls., situated on a hill in the town, and being 305 ft. above low water in the river. There are 55 double discharge Ludlow fire hydrants for which the city pays an annual rental of $2,750, and valves are set at street crossings for use in time of making repairs. There are two Walker pumping engines, each having a capacity of 1,000,000 galls. in 24 hours, and capable of pumping against the aforesaid reservoir head, the water reaching the reservoir through the mains in the town, and not being taken from the reservoir to supply the town except when the pumps are not running. An adequate filter plant has been added this season, by the National Water Purifying Co., thus insuring water of excellent quality. The cost of the works was about $75,000.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 138).

Skowhegan, Me.—The works were commenced Sept. 1, 1887, and were to be completed in July, 1888; at the time of the special report, Feb. 11, 1888, they were about three-quarters completed. They were designed by GEO. ALEXANDER, of Boston, Mass.; and E. H. GOWING was Constructing Engineer. The contractors were as follows: for masonry and foundations, J. W. Gould, of Skowhegan; for buildings, trenching and pipe laying, B. C. Mudge, of Boston, Mass.; for pumping machinery, Henry R. Worthington, of New York; for pipe and specials, M. J. Drummond, of New York; for hydrants, R. D. Wood & Co., of Philadelphia, Pa.; for valves, Ludlow Valve Mfg. Co., of Troy, N. Y.; for stand-pipe, Hodge & Co., of East Boston, Mass. The supply is taken from springs and pumped to a stand pipe, 25 ft. diameter by 75 ft. high, by two compound, condensing, duplex pumping engines with a daily capacity of 1,000,000 galls. each; the boilers are of the horizontal tubular type. There are 12 miles of pipe and 75 hydrants; the mains are of cast-iron and the services of rustless wrought-iron. Ordinary and fire pressures, 70 to 90 lbs. The works are owned by the Skowhegan Water Co.; $125,000 bonds, 5 per cent. $35,000 stock. The present population is 5,000.

Claremont, N. H.—The works were commenced June 1, 1888, and the plant is in operation, but a storage reservoir is being built which will be finished in November. They were designed by N. W. Ellis & Co., who were also the contractors for trenching, pipe laying and reservoirs. The pumping machinery was furnished by the Knowles Steam Pump Co., of New York; the pipe and specials by the New Haven Patent Water Pipe Co., of New Haven, Conn.; and the valves by the Coffin Valve Co., of Boston, Mass. The cement used was furnished by F. O. Norton, of New York. The water is taken from two brooks and will be supplied by gravity, but a pump is being used until the completion of the storage reservoir. There are three reservoirs, with capacities of 2,750,000 galls., 3,250,000 galls. and 22,000,000 galls., the latter not being completed. There is a Knowles direct acting steam pump. There are 8¼ miles of mains, 42 hydrants, 75 taps and 12 meters; the mains are cement pipe, Phipps patent; the services are of cement lined wrought-iron. Average daily consumption, 150,000 galls. Ordinary pressure, 65 to 104 lbs. The hydrant rental is $35 per hydrant per annum. The town has the right to purchase the works within 5 years, by appraisal. The works are owned and operated by N. W. Ellis, & Co. The present population is 5,000 (Date of special report; August 7, 1888).

TO BE CONTINUED.